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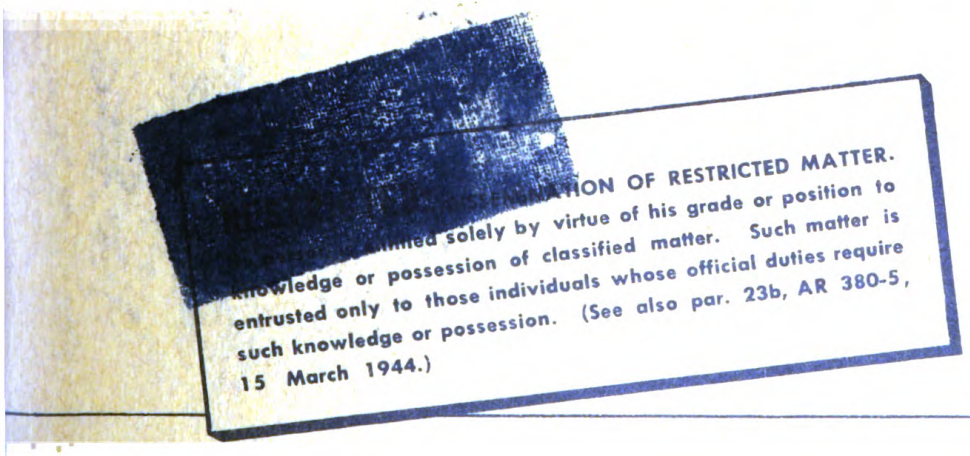
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FLAME THROWER, MECHANIZED, E12-7R1

(INSTALLED IN MEDIUM TANKS M4A1 AND M4A3)

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TM 3-360

FLAME THROWER, MECHANIZED, E12-7R1

(INSTALLED IN MEDIUM TANKS M4A1 AND M4A3)



WAR DEPARTMENT • *20 JULY 1945*

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Washington 25, D. C., 3 May 1945.

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The Adjutant General.

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SAFETY PRECAUTIONS

1. Do not use oxygen under any circumstances to charge the main or auxiliary pressure systems because this will result in a dangerously explosive mixture.
2. Handle and store flame thrower fuels as carefully as motor fuel or gasoline to prevent premature ignition. See AR 850-20.
3. Handle and store compressed air or nitrogen in accordance with AR 850-60 and TB ENG 39.
4. Discharge pressure before loosening, disassembling, or removing any fittings, connections, flanges, parts, or assemblies which may be under pressure.
5. Do not permit personnel to be directly in line with flame gun nozzle while testing ignition or main flame.
6. Only personnel thoroughly trained in these or similar mechanized flame throwers should be permitted to operate, service, or maintain the flame thrower equipment.

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Figure 1–Mechanized Flame Thrower E12-7R1 installed in medium tank M4A1–left side view.

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Part One

INTRODUCTION

Section I. GENERAL

1. SCOPE.

a. These instructions are published for the information and guidance of the personnel to whom this equipment is assigned. They contain information on the operation and maintenance of the equipment as well as descriptions of the major units and their functions in relation to the other components of the equipment. They apply only to the Flame Thrower, Mechanized, E12-7R1 (figs. 1, 2 and 3), installed in medium tank M4A1 or M4A3 and are arranged in five parts: Part One—introduction; Part Two—operating instructions; Part Three—maintenance instructions; Part Four—auxiliary equipment; Part Five—repair instructions; and Appendix.

b. The operating and maintenance details for the vehicle in which the flame thrower is installed, medium tanks M4A1 and M4A3, are given in TM 9-731A and TM 9-759. Supply catalogs, technical manuals and other publications applicable to the material covered by this manual are listed in the reference section in the Appendix.

2. RECORDS.

Forms and records applicable for use in performing prescribed operations are listed below with brief explanations of each:

a. War Department lubrication orders. War Department Lubrication Order 3-360 prescribes lubrication maintenance for this flame thrower. A lubrication order is issued with flame thrower and is to be carried with it at all times. Additional lubrication orders apply to lubrication of the medium tank.

b. W.D., A.G.O. Form No. 478, MWO and Major Unit Assembly Replacement Record. This form, carried with the flame thrower, will be used by all personnel completing a modification or major unit assembly replacement to record clearly description of work completed, date, hours of operation, number of times flame thrower has been fired, and modification work order number or nomenclature of unit assembly. Personnel performing the operation will initial in the column provided. Minor repairs, parts, and accessory replacements will not be recorded.

c. W.D., A.G.O. Form No. 9-81, Exchange Part or Unit Identification Tag. This tag, properly executed, may be used when exchanging unserviceable items for like serviceable assemblies, subassemblies, parts, and tools.

d. W.D., A.G.O. Form No. 468, Unsatisfactory Equipment Report. This form will be used for reporting manufacturing, design, or operational

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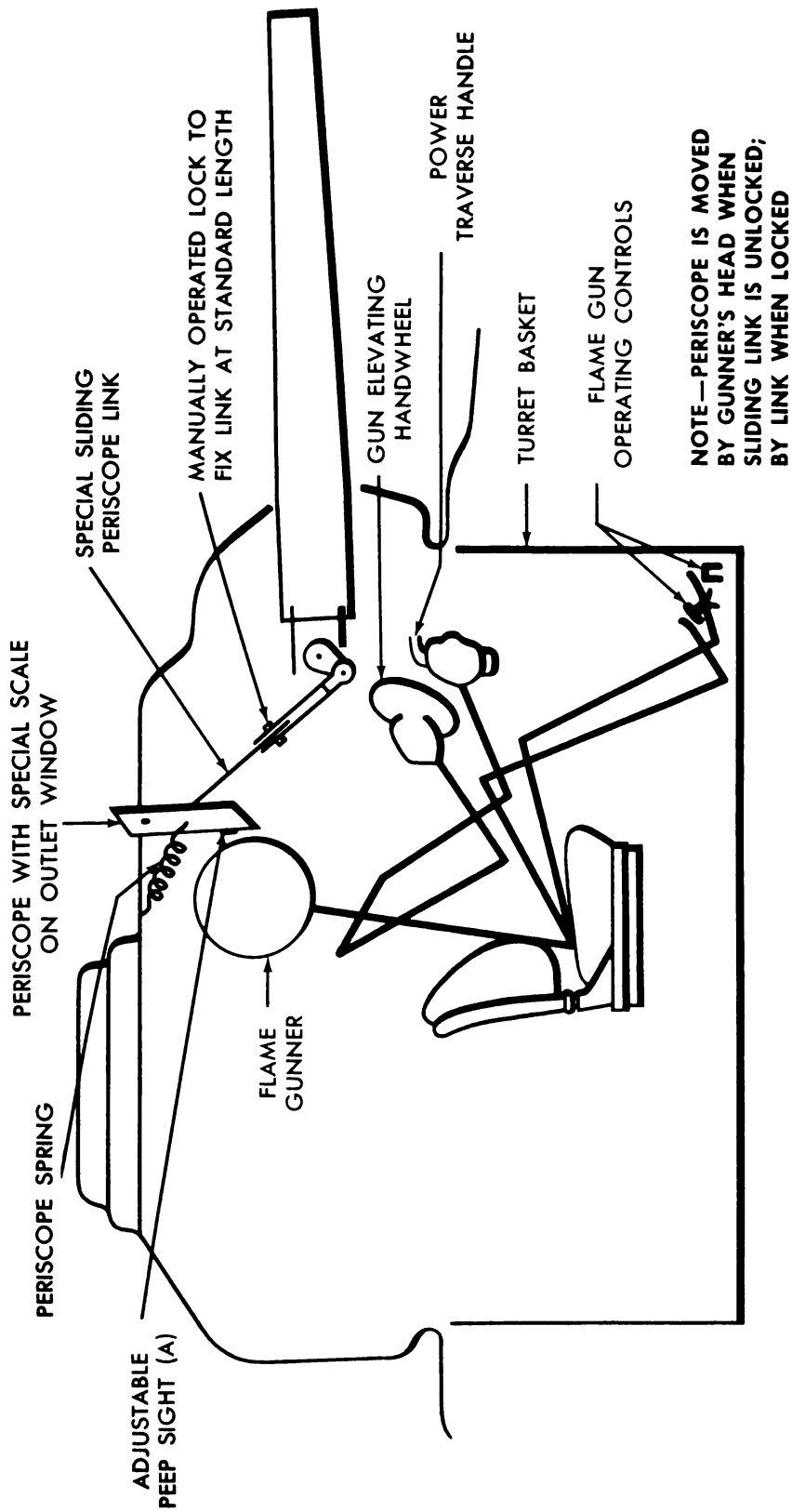


Figure 27—Flame gunner's linked periscope arrangement.

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commander who views the target through the vision cupola. A wide angle periscope is preferred for the flame gunner because of the wider vision angle obtainable as compared with earlier model periscopes. The flame gunner's periscopes provided with the flame throwers are inscribed with horizontal and vertical sighting lines (fig. 28) on the outside window and fitted with a horizontally adjustable special peep sight for the inside window. In addition, the standard gunner's periscope link to the gun mount in the turret has been replaced by a special sliding link which can be locked at a fixed length to operate as a standard link or unlocked to permit manual operation of the periscope. A spring pulls the periscope toward the gunner's head when the special link is unlocked. By pushing against the periscope with his head, the gunner can then elevate or depress the periscope to obtain the field of view desired to follow burning on the target.

b. Adjustment of peep sight.

Before a mission, the flame gunner adjusts his special periscope peep sight to a "zero" setting by firing at a fixed target at 75 yards range or at the average range anticipated during the mission. To do this, proceed as follows:

(1) Bring flame gun to bear on a fixed target placed downwind (no wind or slight tail wind preferable for sight setting) of the flame thrower vehicle at a range of 75 yards or other average range if anticipated (fig. 29). Fire a short ignited burst at target to check aim, using fuel thickened to the same consistency as that to be employed on the mission. Correct flame gun elevation and turret traverse if necessary to obtain a direct hit on the target firing ignited fuel. *Leave the gun and turret in this position once direct hit is obtained, and do not move vehicle nor fixed target until sight setting is completed.*

(2) Lock the flame gunner's sliding periscope rod in its fixed length position.

(3) Set adjustable peep sight parallel with inside window of gunner's periscope by adjusting peep sight set screw which acts as a stop against the periscope window. Lock the set screw in this position with set screw lock nut.

(4) Sitting in flame gunner's seat, place head in normal position against the gunner's periscope head rest so that the maximum field of view permitted by the periscope is obtained. If the target appears above or below the horizontal sight scale line, rotate the top half of the special sliding periscope link rod in the threaded end fitting either clockwise or counterclockwise as necessary to move the periscope to aline the target with the horizontal sight scale line. Lock the rod in this position, using the lock nut provided with the end fitting connecting the rod to the periscope holder. Be sure the corresponding lock nut on the lower half of the sliding periscope link is also tight against the lower fitting securing the link rod to the gun mount when the periscope is alined as above. This alines the periscope in elevation.

(5) With head in same position as in (4) above, move the adjustable peep sight across the periscope inside window to a position in front of

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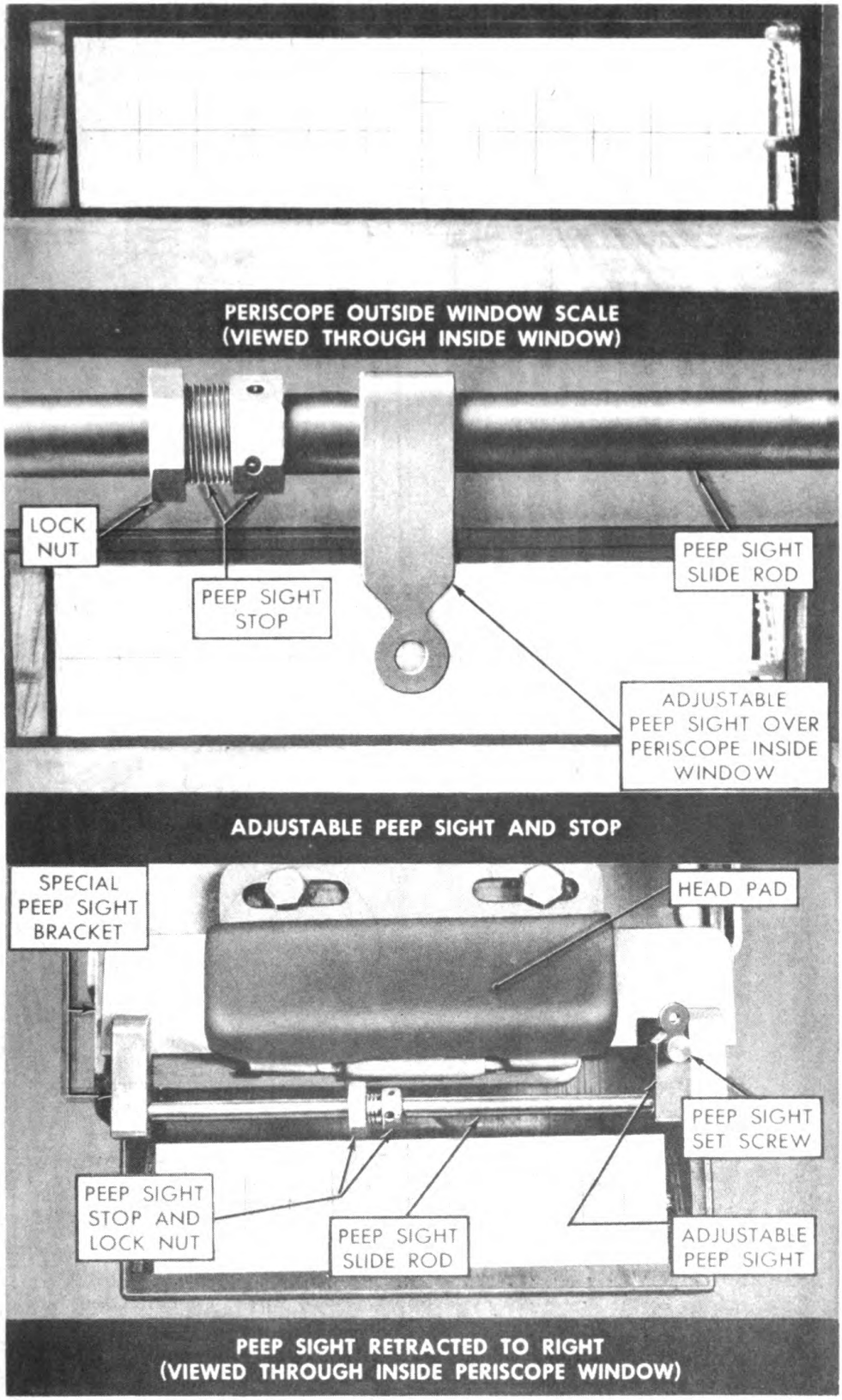
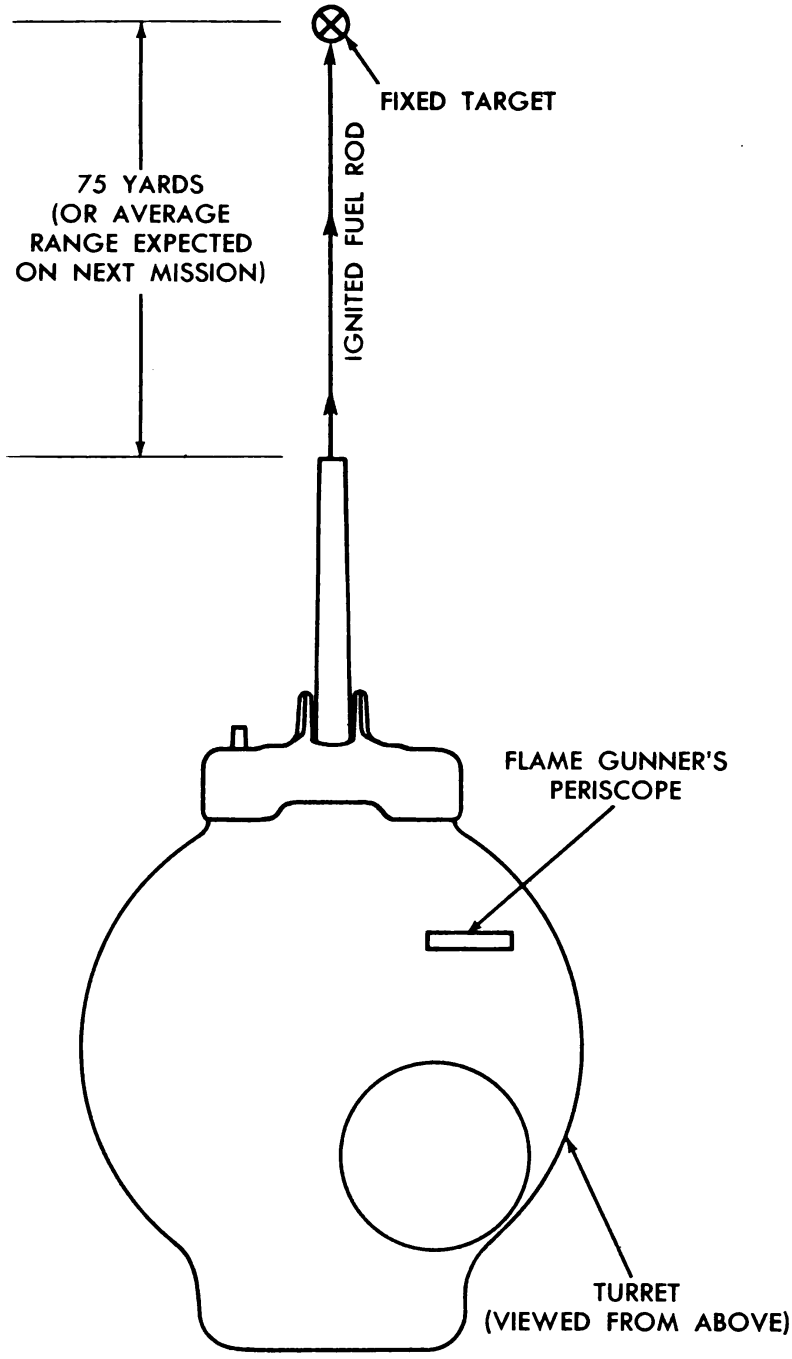
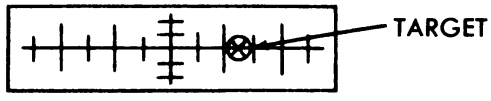


Figure 28—Periscope sight.

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Step 1—Fire Thickened Fuel at Fixed Target at Desired Range in Slight Tailwind or No Wind if Possible—Adjust Elevation and Traverse to Obtain Direct Hit



Step 2—Aline Periscope to Place Target on Periscope Horizontal Sight Line by Adjusting Length of Sliding Periscope Link in Threaded End Fittings with Link Locked

Figure 29A—Alining sight.

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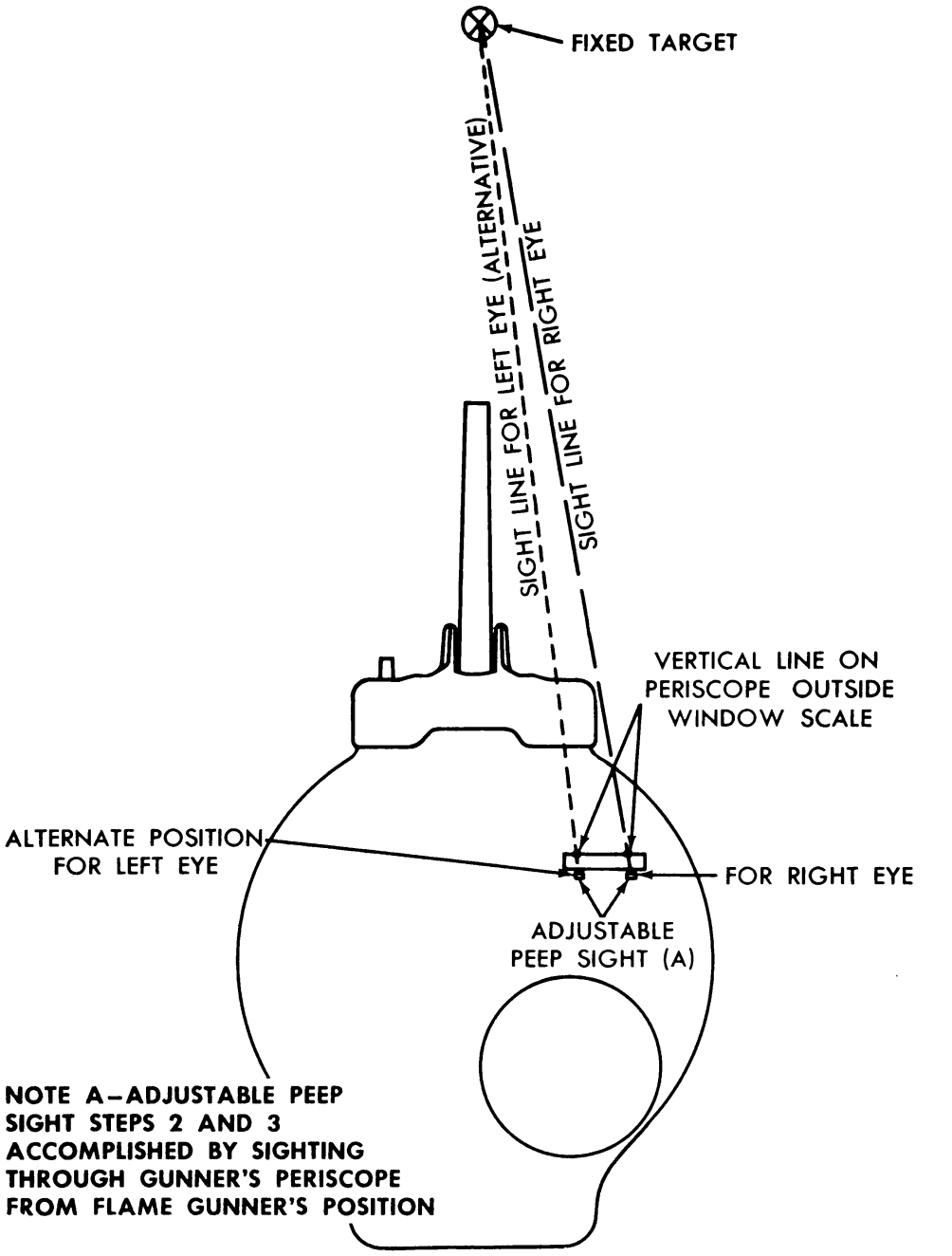


Figure 29B—Alining sight.

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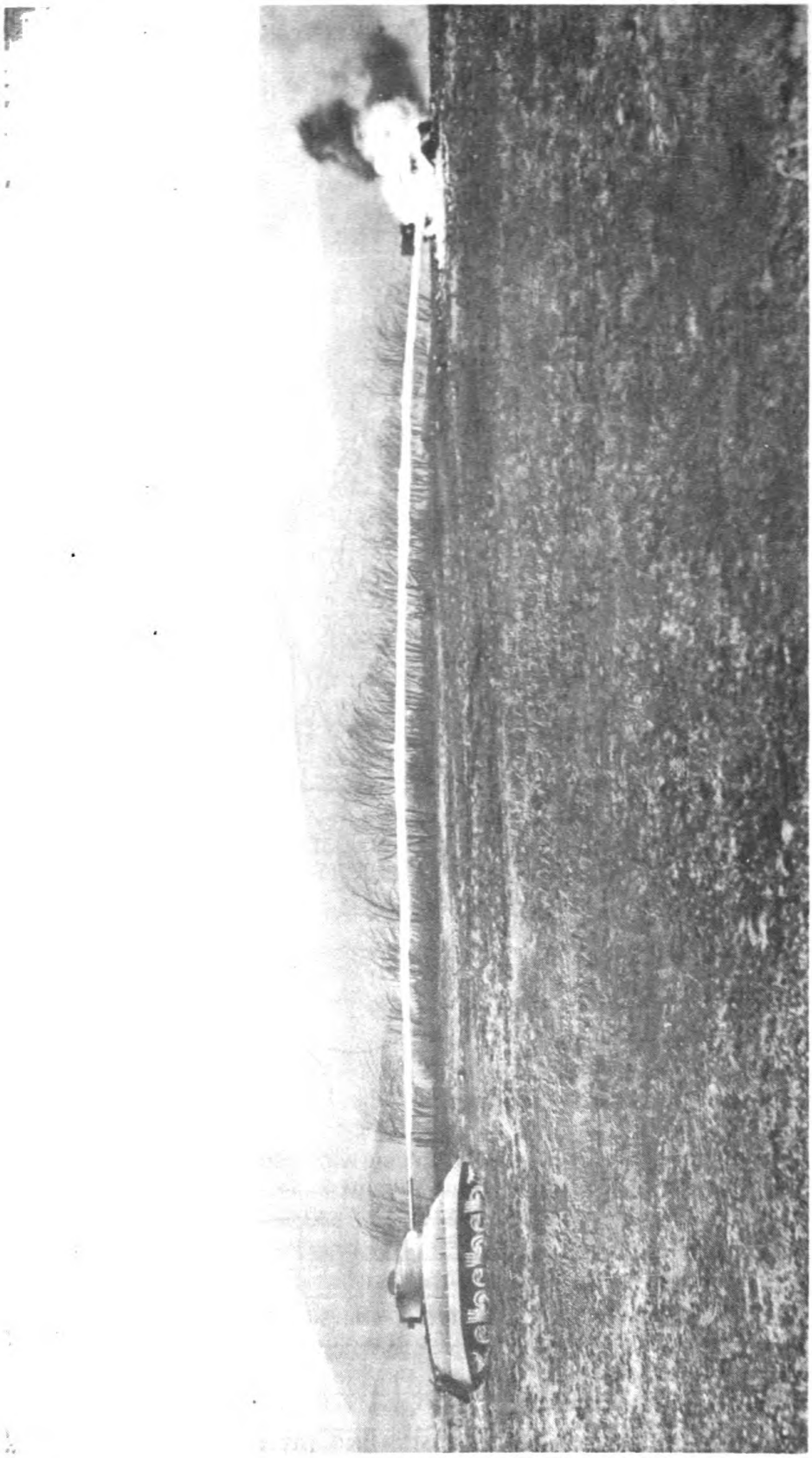


Figure 30—Firing thickened fuel.

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the right or left eye (fig. 30), whichever position is preferred, so that the target lines up with one of the vertical sight scale lines. Hold the peep sight in this position on the horizontal rod on which it slides, and move the peep sight stop to the right until it touches the peep sight. Lock the peep sight stop, with its lock nut, in this position. This alines the peep sight in traverse. If desired, the peep sight can be moved to the extreme right side of the periscope window and rotated upward out of the field of view of the gunner, and can quickly be returned to its proper position against the peep sight stop when desired.

c. Aiming Procedure. When within flame thrower range of the target, the gunner may aim as follows:

(1) Sight target through preset peep sight in periscope; traverse and elevate or depress gun until peep sight hole centers the vertical reference line chosen above, and the horizontal center reference line.

(2) Estimate range to target and readjust gun elevation accordingly, using inscribed horizontal reference lines in periscope outlet window as a guide.

(3) Fire one or two short bursts (one second each) to check and correct aim, if necessary. If firing in a cross wind, alinement in traverse may be aided by sighting through peep sight and traversing turret until a vertically inscribed line to the right or left of the "zero" setting line is brought to bear on the target. This allows for deflection of the fuel rod due to cross winds.

(4) Thorough training of the flame gunner is necessary for accurate estimates of proper aiming allowances to be made under different conditions of wind direction and velocity, and distance to target.

> Note: Experience at short ranges (50-75 yards) indicates that aiming the gun in elevation by means of the periscope generally results in overshooting the target, necessitating a depression correction of 1 to 3 degrees. It is considered preferable to overshoot rather than undershoot on initial short aiming bursts so that the target is not obscured by smoke and burning fuel when correcting aim.

14. RANGES.

a. Ranges for embrasures and openings in fortifications, caves, and other point targets. Effectiveness depends on penetration of the target. The flame thrower should be fired from as close a position as is practicable to the target so that all or most of the flaming fuel will be shot into opening in target and will ricochet and billow within the opening with maximum velocity. Fuel is largely wasted if it is consumed or breaks up in long flight to the target, or if it spatters on the outside wall or slope of the target. The weapon should be close enough so the "rod" or unbroken stream of thickened fuel enters the target opening before it begins to spatter or disintegrate. Tentative range data are given in Appendix, Section III.

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b. Ranges for area targets. For area targets, such as enemy in foxholes, effective ranges may be measured by center of ground deposit on the target. For this reason, effective ranges are much greater than for firing at embrasures, where high velocity of a narrow fuel "rod" is required. Tentative range data are given in Appendix, Section III.

c. Effects of wind. Wind has more effect on flame than on projectiles.

(1) Strong cross winds may reduce range by as much as 20 to 50 percent, depending on velocity, by breaking up the fuel "rod" or stream in flight. Cross winds also affect aiming.

(2) Head winds cause slightly less reduction in range than cross winds of the same velocity.

(3) Tail winds increase range.

d. Effects of nozzle bore. The ¾-inch bore long nozzle extension gives approximately 10 to 25 percent greater range than the ½-inch bore long nozzle extension when measured in terms of center of ground deposit of fuel.

e. Effect of elevation. Elevation of the flame gun up to approximately 20 degrees increases range in terms of center of ground deposit.

f. Liquid fuel. Liquid (unthickened) fuels provide a spectacular flame, but range is very short, and the fuel is largely burned in air before it hits the target. Fuel is wasted on the outside of the target because of the wide flame. Also liquid fuel cannot be fired into strong cross or head winds.

15. FIRING.

To fire flame gun (fig. 30), follow all preparatory steps in paragraph 12. Then proceed as follows:

a. With master switches (hull) (par. 10 a) "on" (fig. 4) push ignition and fuel firing safety switches on (red lights on) (fig. 5) and release mechanical fuel firing safety lock (par. 10 b (5)) (fig. 7).

b. Press left foot down on foot control igniter pedal (fig. 6) and keep it there. This provides an ignition flame (fig. 26). Push main fuel firing button (fig. 8) with right foot. Ignited main fuel is fired from gun. Correct aim if required.

> Note: If special solenoid switch fails to operate, push mechanical emergency fuel firing pedal (fig. 8).

c. To cease or interrupt firing, completely release foot pressure on foot control igniter pedal and main fuel firing button simultaneously and rapidly. Pull trigger (par. 10 f) of CO_2 muzzle fire extinguisher for approximately ½ second after each burst or shot or after a series of rapid bursts.

d. To resume firing after pause between bursts, again first press foot control igniter pedal and then main fuel firing button, holding down both for duration of desired burst.

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16. ESTIMATING SECONDS OF FIRING TIME REMAINING.

After firing, an estimate of the number of seconds firing time remaining can be made by reading the main air pressure gage and comparing it with table 1. A reproduction of this table is permanently installed (1) to the right of the flame gunner in the turret and (2) to the right of the assistant driver.

Table 1

Relationship of main air pressure to amount of main fuel and firing time remaining*

Main Air Pressure Gage (Hull)	Approx. Gallons of Fuel Remaining	Approximate Firing Time Remaining—Seconds	
		½-inch Nozzle	¾-inch Nozzle
2000*	275	125	63
1900	255	116	58
1800	240	109	54
1700	225	102	51
1600	205	93	46
1500	190	86	43
1400	170	77	38
1300	150	68	34
1200	135	61	30
1100	115	52	26
1000	100	45	22
900	80	36	18
800	65	29	15
700	45	20	10
600	30	14	7
500	0	0	0

*Based on units fully charged with 275 gallons of fuel and having 2,000 pounds per square inch of air in containers when ready for firing.

17. AFTER MISSION.

Upon completion of mission, proceed as follows:

a. Lock fuel firing safety lock and turn off ignition and fuel firing safety switches (red lights go off).

b. If complete main fuel load has been fired, gunner and assistant driver vent main, secondary, and atomizer fuel containers as follows:

(1) Close main pressure regulator inlet valve.

(2) Close main pressure regulator outlet cock.

(3) Close auxiliary air shut-off valve.

(4) Vent the pressure from main fuel containers by slightly opening main fuel vent cock.

(5) Vent the air from secondary and atomizer fuel containers by opening dummy periscope cover (left turret roof), and then opening secondary and atomizer fuel vent cocks (fig. 16).

c. Fill out an inspection and performance record noting any deficiencies in operation, so that they may be corrected.

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18. IF NEW MISSION IS TO FOLLOW IMMEDIATELY.

The fully serviced flame thrower is capable of the approximately 125 seconds total firing time with ½-inch bore long nozzle extension and 63 seconds with ¾-inch bore long nozzle extension. If a given mission has resulted in appreciably less than total firing time, other missions may be conducted, depending on the additional firing time available. If immediate use is planned for other missions, do not as yet perform the duties outlined in paragraph 17.

Section VIII. OPERATION UNDER UNUSUAL CONDITIONS

19. ADVERSE WEATHER CONDITIONS.

a. The mechanized flame thrower can be used under wet or dry conditions and in hot or cold weather.

b. Cold weather tends to reduce ignition of thickened fuel, particularly if combined with high cross or head winds. Under these adverse conditions, use maximum rate of secondary fuel (300 cubic centimeters per second) by increasing outlet pressure of secondary fuel pressure regulator to approximately 540 pounds per square inch. If this fails to give satisfactory ignition of main fuel, use lower viscosity thickened fuels.

c. Firing into high cross or head winds should be avoided as much as possible when the tactical situation permits because of appreciably reduced range.

d. If atmospheric temperature rises appreciably after setting the main pressure regulator, the latter should be readjusted (par. 57 b) so that outlet pressure does not become too high.

e. If atmospheric temperature drops appreciably after setting the main pressure regulator, the latter should be readjusted (par. 57 b) so that outlet pressure does not become too low.

f. When vehicle is not being operated, keep canvas cover over muzzle end of special dummy 75-mm. rifle tube to protect the nozzle and ignition chambers from rain and dust.

Section IX. DEMOLITION TO PREVENT ENEMY USE

20. DESTRUCTION PROCEDURE.

a. Destruction of the materiel, when subject to capture or abandonment in the combat zone, will be undertaken by the using arm only when in the judgment of the military commander concerned such action is deemed necessary and as a final resort to keep the materiel from reaching enemy hands.

b. To destroy the flame thrower, demolish the medium tank, using the technique prescribed for the vehicle. In an emergency, destruction of the main pressure regulator or auxiliary regulators will effectively put the flame thrower out of action.

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Part Three

MAINTENANCE INSTRUCTIONS

Section X. GENERAL

21. SCOPE.

Part Three contains information for the guidance of the personnel of the using organizations responsible for the 1st and 2nd echelon maintenance of this equipment. It contains information needed for the performance of the scheduled lubrication and preventive maintenance services as well as descriptions of the major systems and units and their functions in relation to other components of the equipment.

Section XI. SPECIAL ORGANIZATIONAL TOOLS AND EQUIPMENT

22. GENERAL.

Special organizational spare parts, tools, and equipment for the flame thrower are requisitioned through normal supply channels. Service units, mechanized flame thrower, E8 or E8R1, normally serve as fueling and pressure charging equipment and their use with the flame thrower is described in Section XXVII. Other methods of fueling and pressure charging are also described in Section XXVII.

Section XII. LUBRICATION

23. LUBRICATION ORDER.

a. War Department Lubrication Order LO 3-360 (fig. 31) prescribes first and second echelon lubrication maintenance for the flame thrower. A separate lubrication order is issued for the medium tank.

b. A lubrication order is placed on or is issued with each item of materiel and is to remain with it at all times. In the event the materiel is received without a lubrication order, the using arm shall immediately requisition a copy from Adjutant General Depots. See lists in FM 21-6.

c. Instructions on the lubrication order are binding on all echelons of maintenance and there shall be no deviations.

d. Service intervals specified on the lubrication order are maximums for operation during active service. Intervals may be extended during inactive periods.

e. Lubricants are prescribed in the "key" of the lubrication order in accordance with three temperature ranges, "above +32°F," "+32°F to 0°F," and "below 0°F". When to change grades of lubricants is determined by maintaining a close check on operation of the equipment during the approach to change-over periods. Sluggish operation may be an indication of lubricants thickening and the signal to change to grades prescribed for the lower temperature range. It will be necessary to change

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TENTATIVE
WAR DEPARTMENT LUBRICATION ORDER LO 3-360

1 JUNE 1945

FLAME THROWER, MECHANIZED, E12-7R1

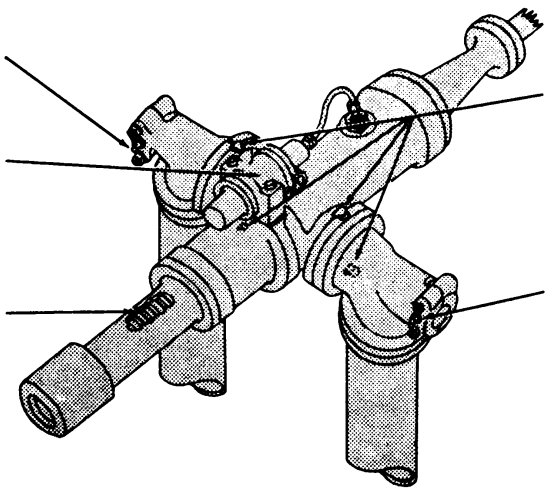
References: TM 3-360, (For Vehicle see WDLO and TM aslisted in FM 21-6)

Intervals given are maximums for operation during active service. Intervals may be extended during inactive periods.

Clean fittings before lubricating.
Clean parts with SOLVENT, dry cleaning, or with OIL, fuel, Diesel.

Lubricant • Interval

Interval • Lubricant



Trunnion Bearing Cap **CG M**

"0" Rubber Sealing Rings **OE ***
(At Control Valve Piston)
Remove, clean and oil

Main Piston Spring **OE 3M**
Remove, clean and oil

M CG Trunnion Elbow Flanges
(4 fittings)

M CG Trunnion Bearing Cap

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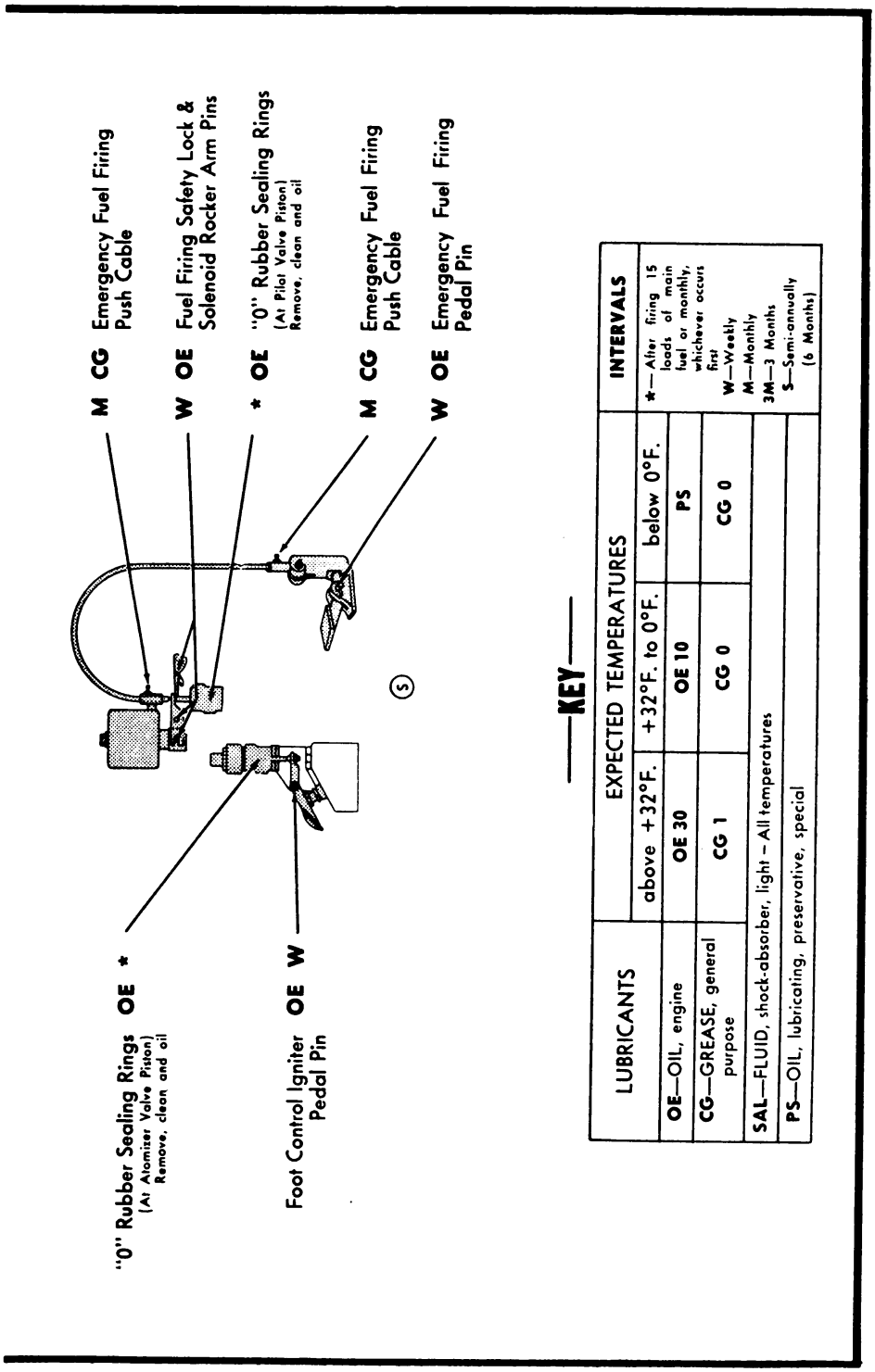
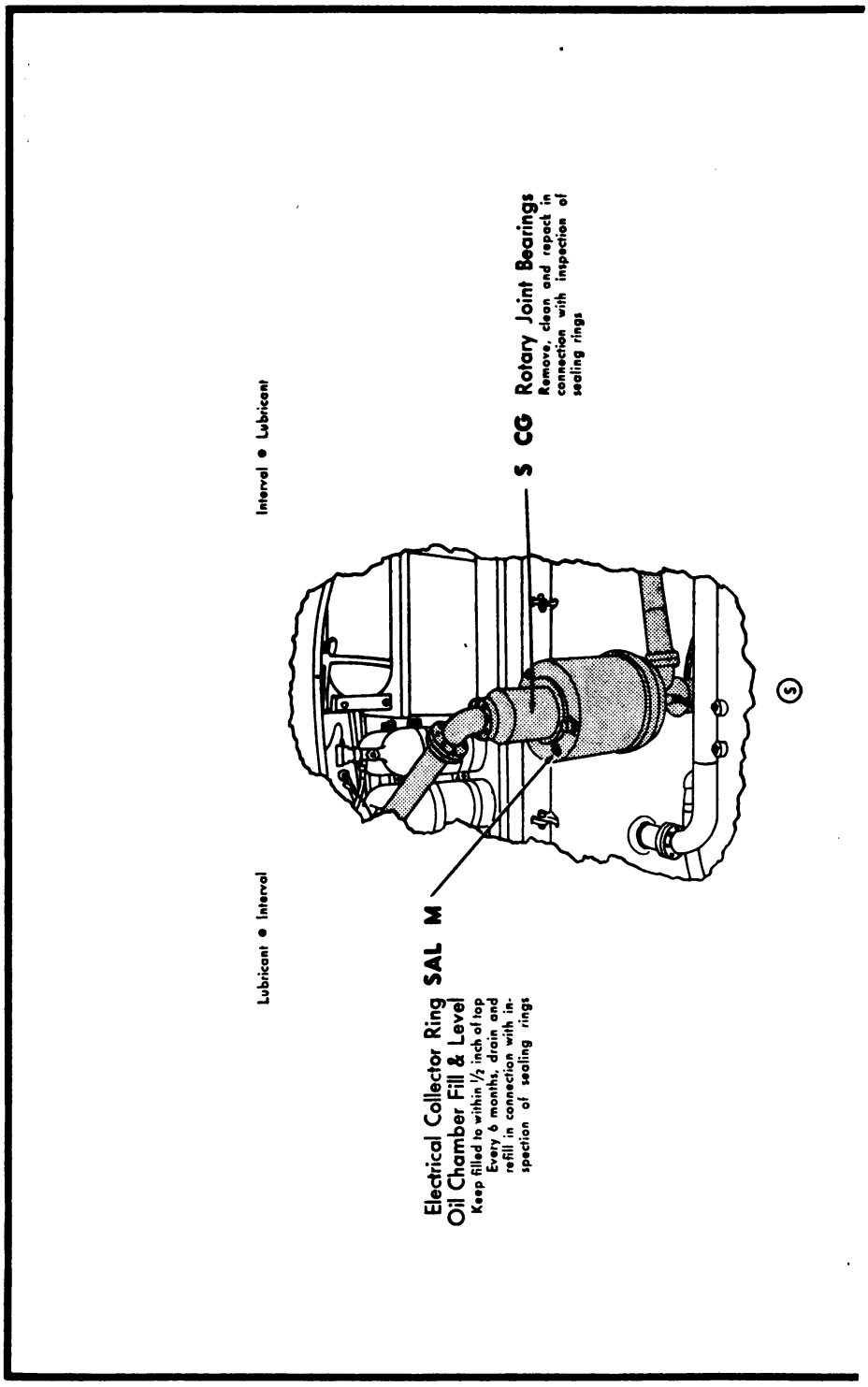


Figure 31a—Lubrication order.

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—NOTES—

1. NORDSTROM COCKS*—Before each mission, turn lubricating screw ½ turn clockwise; insert additional stick of lubricant as needed. CAUTION: For Main Pressure Regulator Outlet Cock use only Valve Lubricant "Nordco" No. 147. Use only Valve Lubricant "Nordco" No. 755 for the following cocks:
   - Main Fuel Vent Cock
   - Secondary Fuel Vent Cock
   - Atomizer Fuel Vent Cock
   - Main Fuel Filling Cock
   - Secondary Fuel Filling Cock
   - Atomizer Fuel Filling Cock
   - Emergency Fuel Shut-Off Cock
   - Secondary Fuel Outlet Cock
   - Atomizer Fuel Outlet Cock

2. "O" RUBBER SEALING RINGS—Lubricate sealing rings in Flame Gun Main Piston and Main Piston Chamber, Rotary Joint Bearing Housing, Electrical Collector Ring Oil Chamber, and at Trunnion Elbow Flanges with OE only when disassembled for inspection or other purpose. Lubricate all new sealing rings with OE before installing.

3. ELEVATING GEAR ADAPTER HOUSING—Every 6 months, disassemble, clean, and repack with CG.

Copy of this Lubrication Order will remain with the equipment at all times; instructions contained therein are mandatory and supersede all conflicting lubrication instructions dated prior to 1 June 1945.
[A.G. 300.8 (1 June 1945.)]
By Order of the Secretary of War:

G. C. MARSHALL,
Chief of Staff.

Official:
J. A. ULIO,
Major General,
The Adjutant General.

LO 3-360

*Lubricating screw of cocks is located adjacent to cock handle on end of cock stem.

Requisition additional Lubrication Orders in conformance with instructions and lists in FM 21-6

Figure 31b—Lubrication order.

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grades of lubricants only when atmospheric temperatures are consistently in the next higher or lower range.

24. LUBRICATION INSTRUCTIONS.

a. Lubrication equipment. The apparatus is supplied with lubrication equipment adequate to maintain the materiel. Be sure to clean this equipment both before and after use.

b. Points of application. Lubrication points are readily located by reference to the lubrication order. Service instructions are amplified by the "notes" on the lubrication order. The following supplements these notes.

(1) *Flame gun main piston spring.* This spring is a highly stressed part of the mechanism and must be protected by a film of lubricant against corrosion to prevent premature failure. At indicated intervals, remove spring and wash in dry cleaning solvent. Dip in engine oil and drain excess oil before reinstalling.

(2) *Electrical collector ring oil chamber.* For replenishing the oil or refilling after draining, be sure to use a clean, dry container. Moisture in the oil will destroy its insulating property and may cause short circuits.

(3) *Special rotary joint bearings.* After cleaning, dry thoroughly before repacking with general purpose lubricant. Do not use compressed air for drying.

c. Cleaning. Use dry cleaning solvent or Diesel fuel oil to clean or wash all parts. After washing, dry all parts thoroughly before applying lubricant.

d. Reports and records.

(1) Report unsatisfactory performance of materiel to the Chemical Warfare Service officer responsible for maintenance.

(2) A record of lubrication shall be maintained in W.D., A.G.O. Form No. 6 Duty Roster.

Section XIII. PREVENTIVE MAINTENANCE SERVICES

25. GENERAL.

Preventive maintenance services, as prescribed by Army Regulations, are a function of using organization echelons of maintenance. These services consist of services performed by the tank crew and services performed by organizational maintenance personnel.

26. BEFORE OPERATION SERVICE OF FLAME THROWER.

The following services are to be performed before filling and pressure charging the flame thrower:

a. Strainer in main fuel filling line (fig. 32). Remove and clean fuel strainer by washing with motor fuel. Then blow strainer dry.

b. Servicing ignition system (fig. 33). See Section XXIII before servicing for detailed information.

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(1) Remove special dummy 75-mm. rifle tube cover (par. 73).

(2) Clean ignition chamber of any fuel residual or carbon which may be present.

(3) Inspect spark plugs for cracks in insulation. Replace if insulation is cracked or plug is otherwise damaged.

(4) Check and adjust gap between spark plugs and ground electrodes to more than $\frac{1}{16}$-inch but not more than $\frac{1}{8}$-inch maximum, and clean the ground electrodes.

(5) Check position of fuel atomizer nozzle. Nozzle should be in line with hole in ballistic plate and should be $\frac{3}{4}$-inch to 1-inch (preferably $\frac{3}{4}$-in) behind rear edge of plate. Make sure nozzle tip and clamp are tight.

(6) Inspect 7-mm. high tension ignition cables leading to spark plugs. Make sure that connections are tight and that insulation of 7-mm. high tension ignition cables is not damaged (par 70 b (3)).

(7) Check carbon dioxide fire extinguisher ("muzzle snuffer") in ignition system to see that 4-pound bottle is full and that CO_2 is ejected properly through CO_2 line holes in front and in back of ballistic plate in special dummy 75-mm. rifle tube (par. 71, fig. 33).

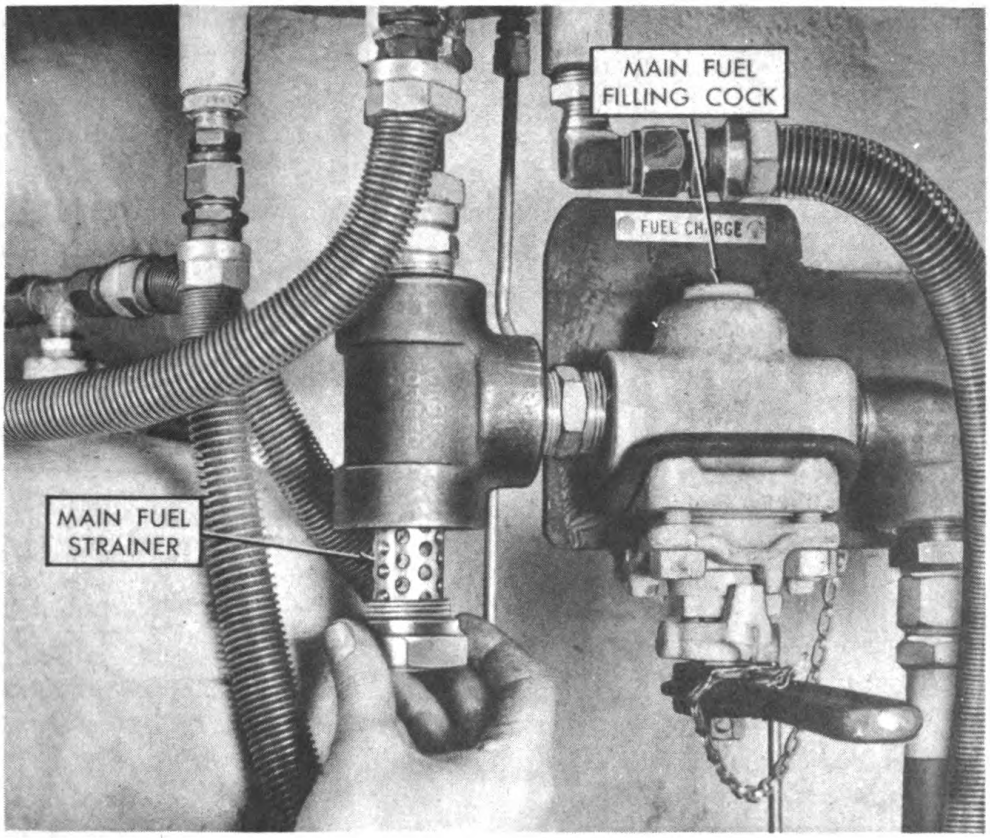


Figure 32—Removing main fuel filling line strainer.

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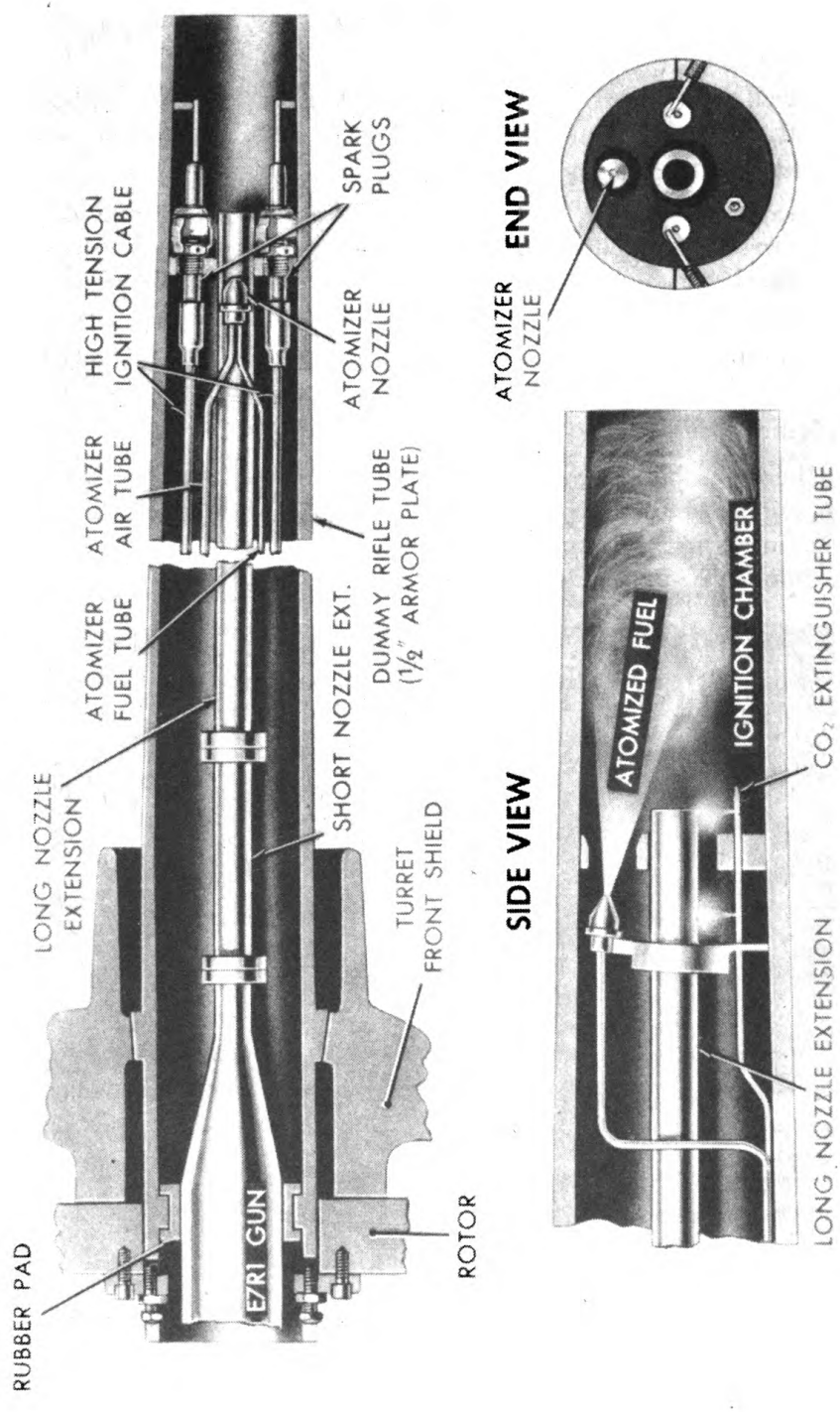


Figure 33—Ignition chamber at front of dummy 75-mm. rifle tube (schematic views).

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c. Batteries. Test for charge. Recharge or replace with freshly charged batteries if necessary.

d. Ignition spark. Test dual ignition sparks by operating foot control igniter pedal (par. 70).

e. Special solenoid switch. Test operation of special solenoid switch.

CAUTION: This should be done only when there is no pressure on flame gun and auxiliary systems.

f. Flame gun flange screws. Using proper size hex socket head screw wrenches, check all accessible hex socket head cap screws on the gun and nozzle flanges for tightness (fig. 33).

g. Safety lock switches. Lock fuel firing safety lock (fig. 7). Turn off ignition and fuel firing safety switches.

h. Long nozzle extensions. Remove long nozzle extension (par. 61) and inspect. The bore must be clean and free from any thickened fuel, dirt, and obstruction. If necessary, clean thoroughly, using a rifle cleaning rod and swabs soaked with motor fuel.

27. AFTER OPERATION SERVICE OF FLAME THROWER.

a. Closing safety lock and switches. Upon completion of mission, lock the fuel firing safety lock and place ignition switch, fuel firing switch, and machine gun safety switch in off position.

b. Venting fuel systems. If complete main fuel load has been fired, as soon as practical, vent the main, secondary, and atomizer fuel systems as follows:

(1) Close main pressure regulator inlet valve (par. 10 c (2)).

(2) Close main pressure regulator outlet cock (par. 10 c (3)).

(3) Close auxiliary air shut-off valve (par. 10 d (2)).

(4) Drive metal grounding stake into ground. Slowly and slightly open vent cocks (pars. 10 c (4) and 10 d (6)) of main fuel, secondary fuel, and atomizer fuel systems.

c. Correcting failures and reporting. Correct any failures and difficulties, or report them as soon as possible to service or maintenance personnel. Furnish record of mission including difficulties encountered and especially amount of fuel used (total firing time). See paragraph 2 f for suggested form.

28. SERVICE AFTER FIRING FIFTEEN LOADS OF MAIN FUEL.

After the flame thrower has fired fifteen loads of main fuel or if one month's time has elapsed since the previous inspection, the following services should be carried out by experienced personnel:

a. Perform before and after firing services as outlined in paragraphs 26 and 27.

b. Remove main control valve (par. 63 b), pilot valve (par. 64 b), and atomizer valve (par. 65 b) to inspect "O" rubber sealing rings. Replace

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sealing rings, if necessary, but in any event clean and lubricate with light engine oil before reinstalling.

c. Fill main fuel containers with Diesel fuel oil and allow to stand for 24 hours. Then test fire at a suitable test range or area to flush oil and any residual thickened fuel out of fuel containers (par. 15).

CAUTION: Do not fill main fuel container with water as a substitute for Diesel fuel oil.

d. Check tightness of all hose couplings, pipe unions, and flanged joints of flame thrower, including flame gun.

e. Clean all strainers in fuel and pressure systems. This includes secondary fuel and atomizer fuel air strainers, and inlet strainers to the various pressure regulators.

f. If tactical and supply conditions permit and if safe area is available, test fire flame thrower with thickened fuel with observer outside vehicle to check ignition flame and main flame characteristics.

Section XIV. MALFUNCTIONS AND CORRECTIONS

29. PRECAUTIONS.

Before disassembling, servicing, or repairing parts which are under pressure, be sure to release pressure. Prior to welding on any containers or lines which have contained fuel (thickened fuel, motor fuel, gasoline, Diesel fuel oil, or fuel blends) remove part from assembly, and flush with water or steam to drive out fuel vapors. Clean and dry repaired part before installation.

30. IGNITION SYSTEM FAILURES.

a. No sparks at spark plugs.

Trouble	*Remedy*
(1) Broken insulator on plug.	Replace broken plug (par. 70 b (4)).
(2) Dirty or wet insulation on plugs.	Clean plug insulator.
(3) Muzzle ground and ground electrodes touching.	Adjust gap between points to 1/16-inch (par. 70 b (4)).
(4) Insulation on high tension ignition cable worn, cracked, or burnt off allowing wire to ground.	Replace with new high tension ignition cable (par. 70 b (3)).
(5) Ignition safety switch or switch circuit faulty.	Check contacts and connections to ignition safety switch.
(6) No electrical power to ignition safety switch.	Check battery. Check wiring and connections to electrical slip-ring (par. 75).
(7) Faulty coil or vibrator.	Replace with spare vibrator only or complete assembly (par. 70 b (2)).

b. Sparks satisfactory, but ignition flame fails to burn properly.

(1) Basket atomizer fuel container empty.	Refill with motor fuel.

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Trouble	*Remedy*
(2) Vent line open, therefore no pressure on basket atomizer fuel container.	Close vent line. Adjust atomizer fuel pressure regulator to 7 to 8 pounds per square inch.
(3) Motor fuel strainer plugged.	Clean strainer.
(4) Orifice in atomizer nozzle plugged.	Remove special dummy 75-mm. rifle tube cover, and atomizer nozzle tip. Clean orifice with fine wire.
(5) Fuel-air mixture is too lean.	Check atomizer air and atomizer fuel regulator pressures. Adjust to 75 pounds per square inch and 7 to 8 pounds per square inch, respectively (par. 59 b). A "lean" mixture burns blue. A "rich" mixture burns yellow. Increasing atomizer air pressure alone or decreasing atomizer fuel pressure alone gives a "leaner" flame. The opposite adjustment in each case gives a "richer" flame.
(6) Fuel-air mixture is too rich.	Same as (5) above.
(7) Atomizer nozzle out of line with respect to ballistic plate.	Adjust position to ¾-inch behind plate and in line with hole in ballistic plate.

c. Fuel continues to flow after atomizer valve is shut.

(1) Fuel continues to flow from atomizer nozzle after atomizer valve is shut.	Atomizer valve stem does not seat properly, requiring cleaning of stem and valve seat, grinding in seat, or replacement (par. 65).
	Atomizer valve piston binds, thus preventing spring closing of valve. Remove valve and correct cause of binding.
	Broken or faulty valve spring. Remove valve and replace spring.

31. MAIN FUEL LEAKS.

a. At flanged pipe or hose connections.	Check tightness of flange screws. Replace flange gaskets or flange bolts and lock washers if necessary.
b. Around special rotary joint in basket.	Replace "O" rubber sealing ring (par. 40 b).
c. From nozzle of flame gun.	Replace fiber at main gun valve disk and examine main gun valve seat in gun. Tighten disk, replacing lock nut (par. 66 d).
d. From spring housing vent hole on main control valve on flame gun.	Replace main valve piston rod "O" rubber sealing rings and polish piston rod (par. 66 d).

32. PRESSURE LEAKS.

a. At pressure shut-off valves.	
(1) Around stem.	Tighten valve bonnet or replace stem packing.
(2) Valve seat.	Replace valve.
b. At air relief valves.	If serious leak, replace with new valve. Return leaky valve to higher echelon for repair and resetting. *Do not tamper with adjustment screw.*

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Trouble	*Remedy*
c. At adjustable hose end couplings.	Tighten coupling end nut or clamping nut.
d. Through high pressure air hose.	Replace hose and end couplings.

33. MALFUNCTIONING OF FLAME GUN.

a. "Drooling" or dripping of main fuel from long nozzle extension (repeatedly) or drooling slightly after firing shot.	(1) Check tightness of disk lock nut (par. 66 d) at main gun valve. (2) Replace fiber disk if damaged (par. 66 d). Use new lock nut. (3) If seat is damaged, replace vertical trunnion (gun body) (par. 67 d). (4) Check main piston spring length. If 13¼ inches or less, replace spring. (5) Check air vent from main piston chamber, main control valve, or main spring housing for obstruction. Clear vent. (6) Check spring in main control valve and pilot valve; replace if defective. (7) Check solenoid core for jamming. (8) Check pilot valve stem (at solenoid bracket) for jamming. (9) Be sure main spring housing nut is tight. (10) Check tightness of gun body cap screws.
b. Failure of main gun valve to open when main fuel firing button or emergency fuel firing pedal is operated.	(1) Make sure auxiliary air shut-off valve is open wide and gun actuating pressure regulator is adjusted to 400 to 420 pounds per square inch. Make sure fuel firing safety lock is off. (2) Disconnect air inlet hose from pilot valve to main control valve, and check flow of air when pilot valve is operated. (3) Disconnect main control valve from vertical trunnion (gun body), and secondary fuel inlet and outlet. Check flow of air through bottom port when pilot valve is operated.
c. Secondary fuel leaks into air outlet line from pilot valve, or out of pilot valve vent.	(1) Replace "O" rubber sealing ring in main control valve bonnet (par. 63 d). (2) Polish piston if scratched.
d. Air leaks from pilot and main control valve, when not firing gun.	Replace "O" rubber sealing rings (pars. 63 d and 64 d) and clean valves thoroughly.
e. Failure of main gun valve.	(1) Close emergency fuel shut-off cock (2-inch cock) on turret floor leading to gun in order to stop main fuel flow immediately. (2) Be sure main spring housing nut is screwed tightly to housing. (3) Remove main piston spring and measure free length. If 13¼ inches or less, replace spring. (4) Remove possible obstruction in gun body or main piston chamber of flame gun.

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Trouble	*Remedy*
f. Mixture of main fuel and air issues from nozzle before main fuel containers are empty. (Denotes lack of secondary fuel.)	(1) In an emergency, close secondary fuel container outlet cock and finish mission. (2) Refill basket secondary fuel container. (3) Reduce secondary fuel delivery rate by reducing secondary fuel regulator pressure. Adjust so that secondary fuel supply is sufficient for one full load of fuel.

34. MALFUNCTIONING OF PRESSURE REGULATORS.

a. Main air pressure regulator.

(1) Pressure too high.	Readjust dome pressure (par. 57 b).
(2) Continued pressure build-up above regulator setting.	Have third echelon clean valve seat and valve of regulator if dirty. Check gasket under valve seat, also condition of valve and valve seat. Replace if necessary (par. 93).
(3) Pressure too low.	Adjust dome pressure (par. 57 b).
(4) Continued low pressure or drop in regulated pressure.	Have third echelon check regulator diaphragm for holes or damage. Replace diaphragm if defective (par. 93). Check and clean air screen inside regulator body as well as external inlet air strainer.
(5) Complete shut-off.	Adjust dome pressure. If this is ineffective, have third echelon replace regulator diaphragm and dome gasket (par. 93). Examine springs.

b. Spring type pressure regulators.

(1) Pressure too high.	Readjust spring tension (turn handwheel counterclockwise).
(2) Pressure too low.	Readjust spring tension (turn handwheel clockwise).
(3) Continued build-up of pressure above desired setting.	Have third echelon check condition of valve and valve seat. Replace parts if damaged. Check condition of diaphragm (pars. 94 and 95).

35. FLAME THROWER RANGE TOO SHORT.

a. Obstruction in nozzle or dirty nozzle.	Remove nozzle and clean or clear out obstruction.
b. Fuel pressure too low.	Readjust main pressure regulator.
c. Excessive pressure drop while firing.	Clean air strainer ahead of and inside main pressure regulator.
d. Mixture of main fuel and air issues from nozzle before main fuel containers are empty. (Denotes lack of secondary fuel.)	(1) In an emergency, close secondary fuel container outlet cock and finish mission. (2) Refill basket secondary fuel container. (3) Reduce secondary fuel delivery rate by reducing secondary fuel regulator pressure. Adjust so that secondary fuel supply is sufficient for one full load of fuel.

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Section XV. GENERAL DESCRIPTION OF SYSTEMS

36. GENERAL.

General placement of equipment is shown in figures 34 and 35 and a simplified flow plan of the design is shown in figure 36. A schematic diagram of the E12-7R1 mechanized flame thrower as installed in the M4A1 is given in detail in Appendix, figure 1. Code numbers or letters, such as AH1, are painted on fuel and pressure containers for identification. The following systems are provided for operation of the flame thrower:

a. Main fuel. The hull accommodates two horizontal, internally baffled, main fuel containers. A third vertical main fuel container is carried in the turret basket. All three fuel containers are connected in series, so that fuel flows from one into another.

b. Main pressure. Two pressure containers are located one each in the right and left sponsons, connected to four smaller containers located around the hull fuel containers. The term "air" or "pressure" are generally used in this manual to designate either compressed air or compressed

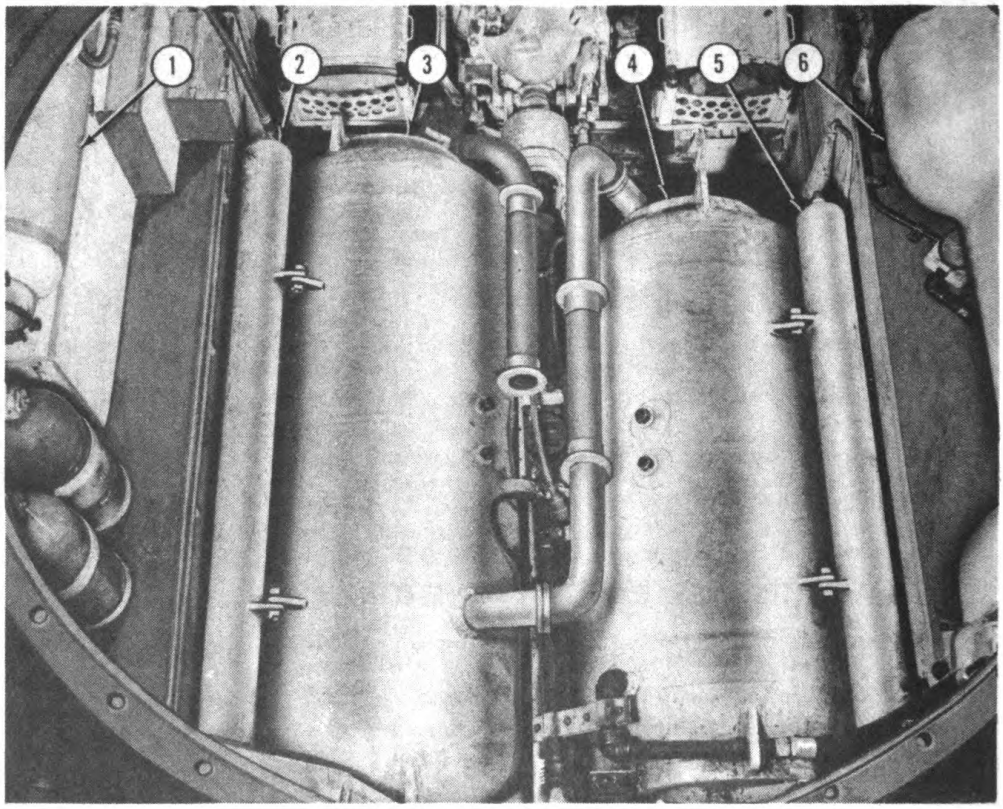


Figure 34—Main fuel and pressure containers in hull.

1. Main Pressure Container, AH-2
2. Main Pressure Container, AH-6
3. Hull Main Fuel Container, FH-2
4. Hull Main Fuel Container, FH-1
5. Main Pressure Container, AH-4
6. Main Pressure Container, AH-1

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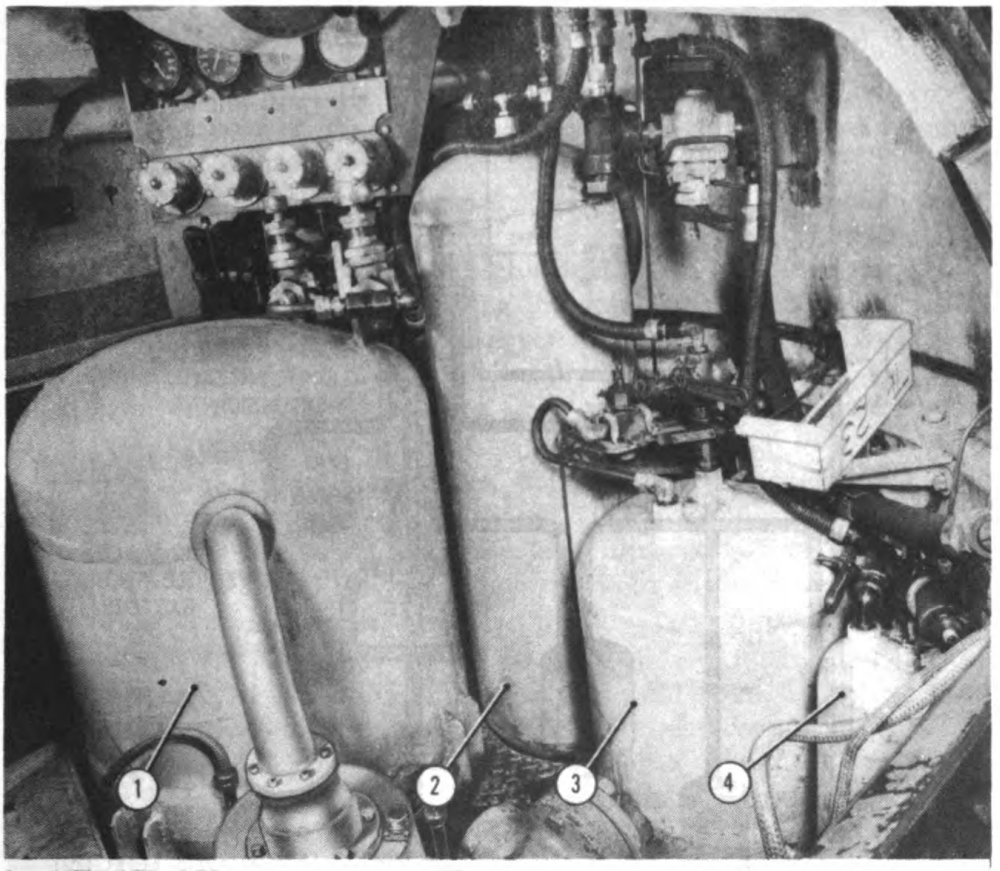


Figure 35—Containers in turret basket.

1. Turret Main Fuel Container, FB-1
2. Basket Auxiliary Pressure Container, AAB-1
3. Basket Secondary Fuel Container SFB-1
4. Basket Atomizer Fuel Container, ATB-1

nitrogen, used for fuel propellant and for gun actuation.

c. Auxiliary air, secondary fuel, atomizer fuel. Auxiliary air, secondary fuel, and atomizer fuel are carried in three containers in the turret. The secondary fuel provides a coating of motor fuel or gasoline around the main fuel stream or "rod" as it leaves the flame gun nozzle, thus insuring complete ignition of thickened fuel stream or "rod" when operating in cross winds and at low temperatures.

d. Ignition. Motor fuel from the basket atomizer fuel container passes under pressure through the atomizer nozzle installed near the end of the special dummy 75-mm. rifle tube, is mixed and atomized with air, and is ignited by dual spark plugs. This pilot flame (fig. 26) ignites the main fuel stream leaving the flame gun. Twelve-volt electrical current for the two high tension spark plugs is drawn from the 12-volt storage battery circuit of the vehicle.

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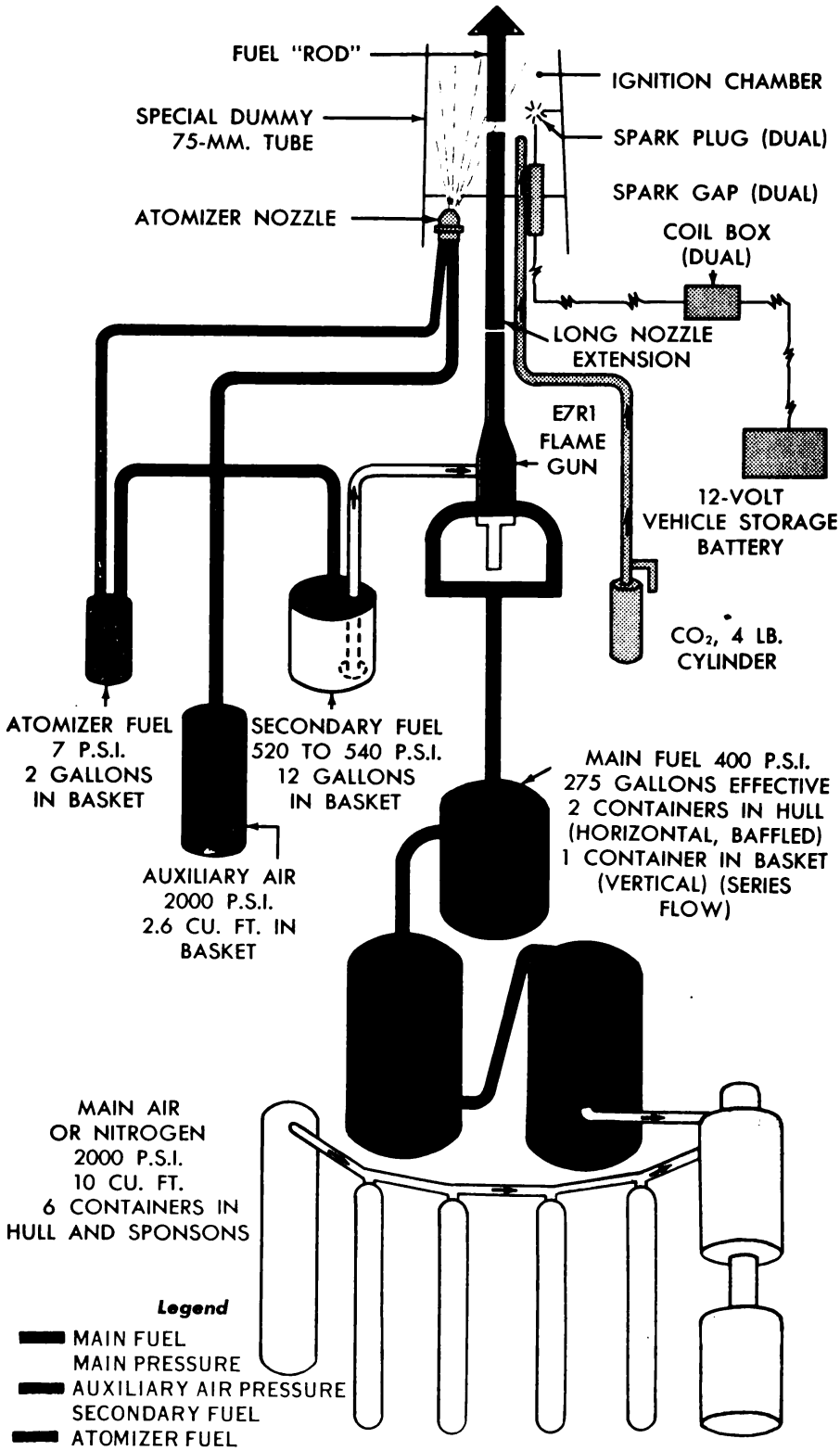


Figure 36—Simplified flow plan of mechanized flame thrower E12-7R1 in medium tank M4A1.

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Section XVI. MAIN FUEL SYSTEM

37. DESCRIPTION OF MAIN FUEL SYSTEM.

A detailed layout of the main fuel system and the connections to other parts of the mechanized flame thrower is given in figure 37.

a. Main fuel containers. The main fuel system (fig. 37) includes three main fuel containers, two of which are placed horizontally in the hull and one vertically in the turret. The hull main fuel containers each have an internal vertical bulkhead dividing the vessel into two equal compartments, with a 3-inch pipe connection leading from the bottom of one compartment to the top of the other. All main fuel containers are piped in series to form what is essentially a single reservoir of approximately 290 gallons gross fuel capacity.

b. Main fuel filling connection. The 1-inch main fuel filling connection is located externally in a protected well in the roof of the turret (fig. 24). Inside the turret, this line leads through a fuel strainer and 1-inch cock (fig. 32) to the fuel piping manifold on the flame gun. Thus, when filling the fuel system, fuel flows in the reverse direction to its flow when the gun is fired.

c. Vent and overflow fuel line. Air is forced from the top of each container in succession during fuel filling. The rear compartment of the right hull main fuel container is equipped with a 1-inch vent and overflow fuel line having a 1-inch cock and leading to the outside of the vehicle alongside the right rear hull ventilator (fig. 25). This line serves to vent the main fuel system of pressure and also indicates when the three fuel containers are completely filled. Main fuel filling is stopped when fuel overflows through this vent. For the latter operation, an overflow fuel hose is connected outside the hull to lead the excess fuel away from the vehicle.

d. Safety head disk (fig. 38). The fuel system is equipped with safety head disk. This is located on one side of a tee in the pressure discharge line from the main pressure regulator leading to the right hull main fuel container. It is bracketed to the rear bulkhead, over the engine oil cooler. The discharge side is piped to the outside of the vehicle through a hole in the hull floor. The safety head disk is a lead-tin coated copper diaphragm which bursts at 600 pounds per square inch pressure, protecting the main fuel containers against excessive pressure.

e. Flexible hose. In the piping which connects the hull main fuel containers with the special rotary joint are two wire-braid reinforced, synthetic rubber, flexible hoses. These hoses prevent strain in the piping and leakage at flange joints due to vibration or motion (fig. 34). A similar hose is placed in the outlet line from the basket main fuel container leading to the flame gun.

f. Special rotary joint (figs. 39 and 40). The purpose of the special rotary joint is two-fold:

(1) To carry main fuel from the hull main fuel containers to the basket main fuel container through 360-degrees traverse of the turret.

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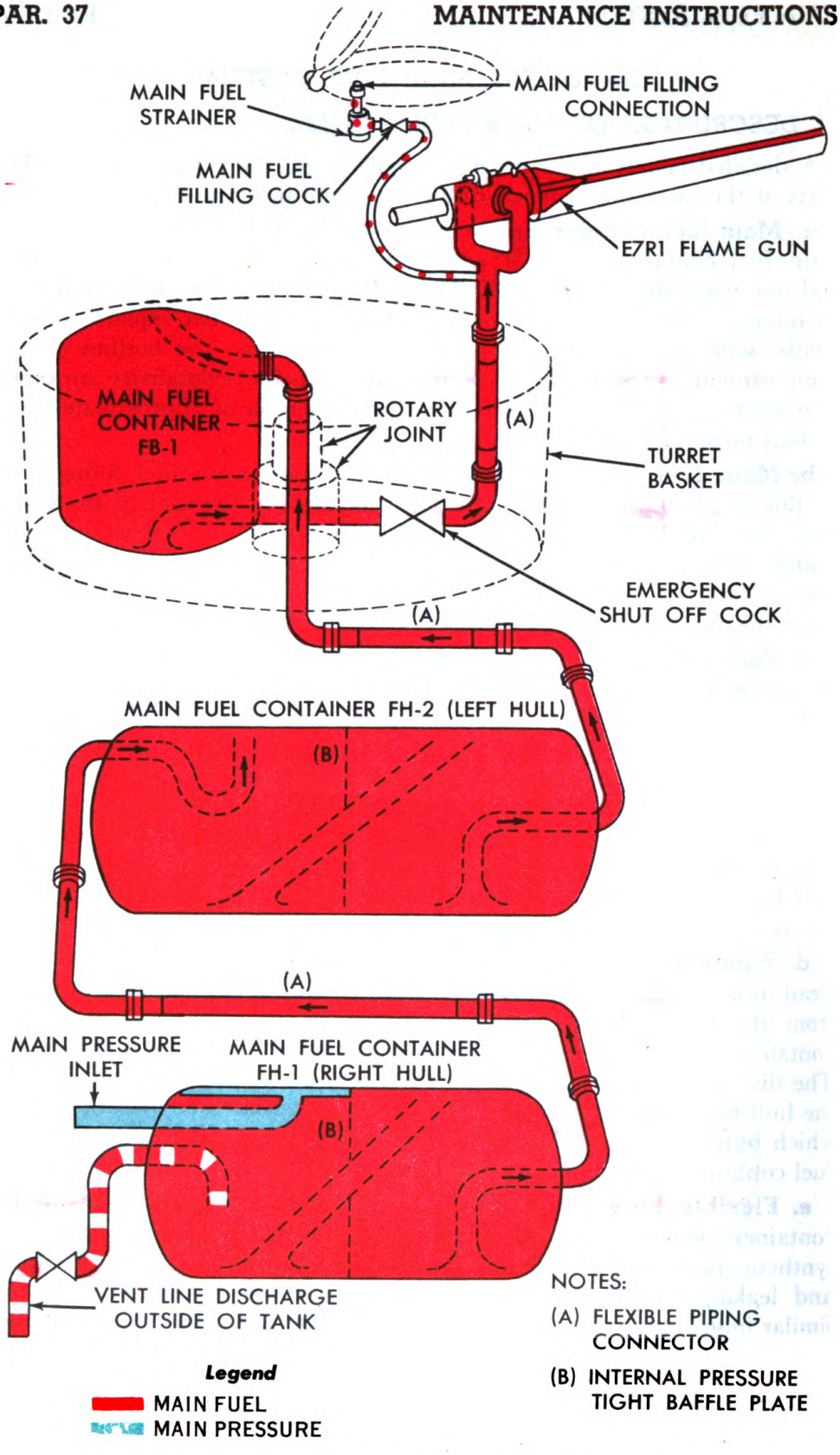


Figure 37—Flow diagram of main fuel system.

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(2) To carry the standard multiple electric power and interphone circuits from hull to turret through 360-degrees traverse of the turret.

38. MAINTENANCE OF MAIN FUEL SYSTEM.

a. Main fuel containers. To clean out containers after 15 fuel fillings or the equivalent in training, follow procedure described in paragraph 28.

b. Piping. Check tightness of couplings, unions, and bolts at flanged connections to insure against leaks. Remove and clean strainer in fuel filling line inside turret.

c. Flexible hoses. If necessary to replace flexible synthetic rubber hose connections in hull, this may be done without removing turret as follows:

(1) Remove gunner's seat from turret.

(2) Lift trap door in basket floor.

(3) Rotate turret until opening in floor is over flanged connection. (Forward flanges may be reached from driver's and assistant driver's seats.)

(4) Unbolt flange on flexible hose connections.

(5) Remove flexible connection.

(6) Reverse above procedure to install new connector. Aline flange holes so that flexible connector is not twisted or bent. Install new gaskets in flanged joints.

d. Safety head disk. To replace safety head disk (fig. 38):

(1) Uncouple the pressure inlet line leading to the swing check valve, the discharge line connected to the safety head, and the pressure inlet line to the hull main fuel containers.

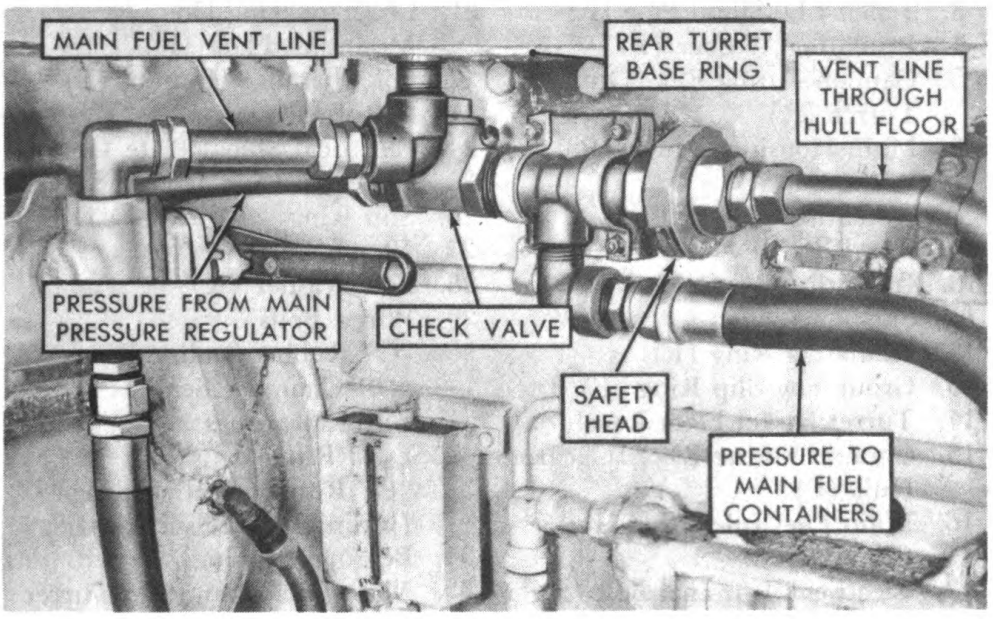


Figure 38—Main fuel system safety head and connections.

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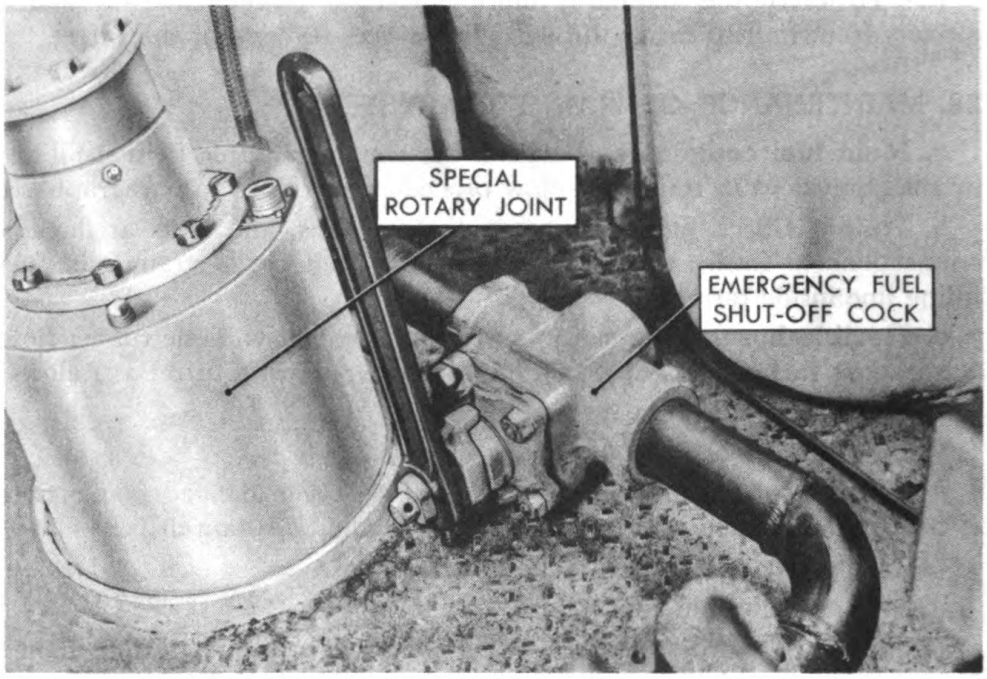


Figure 39—Special rotary joint between hull and turret (combination electrical collector ring and fluid joint).

Legend for Figure 40

1. Outlet Flange Face (R)
2. Mounting Groove
3. 2-inch I.D. Stand Pipe (F)
4. Insulating Washer (F)
5. Cannon Fitting Elec. Outlet to Turret (R)
6. Main Housing Flange (R)
7. Locknut (F)
8. Insulating Rings (F)
9. Slip Ring (F)
10. Insulating Ring (F)
11. Slip Ring (F)
12. Insulating Ring (F)
13. Grounding Slip Ring (F)
14. Turret Basket Floor Level
15. Cannon Fitting Elec. Inlet from Hull (F)
16. Main Fuel Inlet from Hull Containers
17. Electrical Terminal Bolt (F)
18. Wired Bolts
19. Synthetic Rubber Grommet
20. Oil Chamber Bottom Plate (F)
21. Collector Ring Housing Mounting Plate (R)
22. Oil Chamber Housing (F)
23. 24-volt Section
24. Electrical Shield Plate (R)
25. Collector Ring Housing (R)
26. Slip Rings (F)
27. 12-volt Section
28. Felt Washer (R)
29. Wired Bolts
30. "O" Rubber Sealing Rings (Oil Chamber Seal)
31. Thrust Bearings
32. Lock Ring (F)
33. "O" Rubber Sealing Ring (Main Fuel Pressure Seal)
34. Bearing Housing
35. Main Fuel Channel to Turret Fuel Container

Note: (F)=Fixed with Hull (R)=Rotating with Turret Basket

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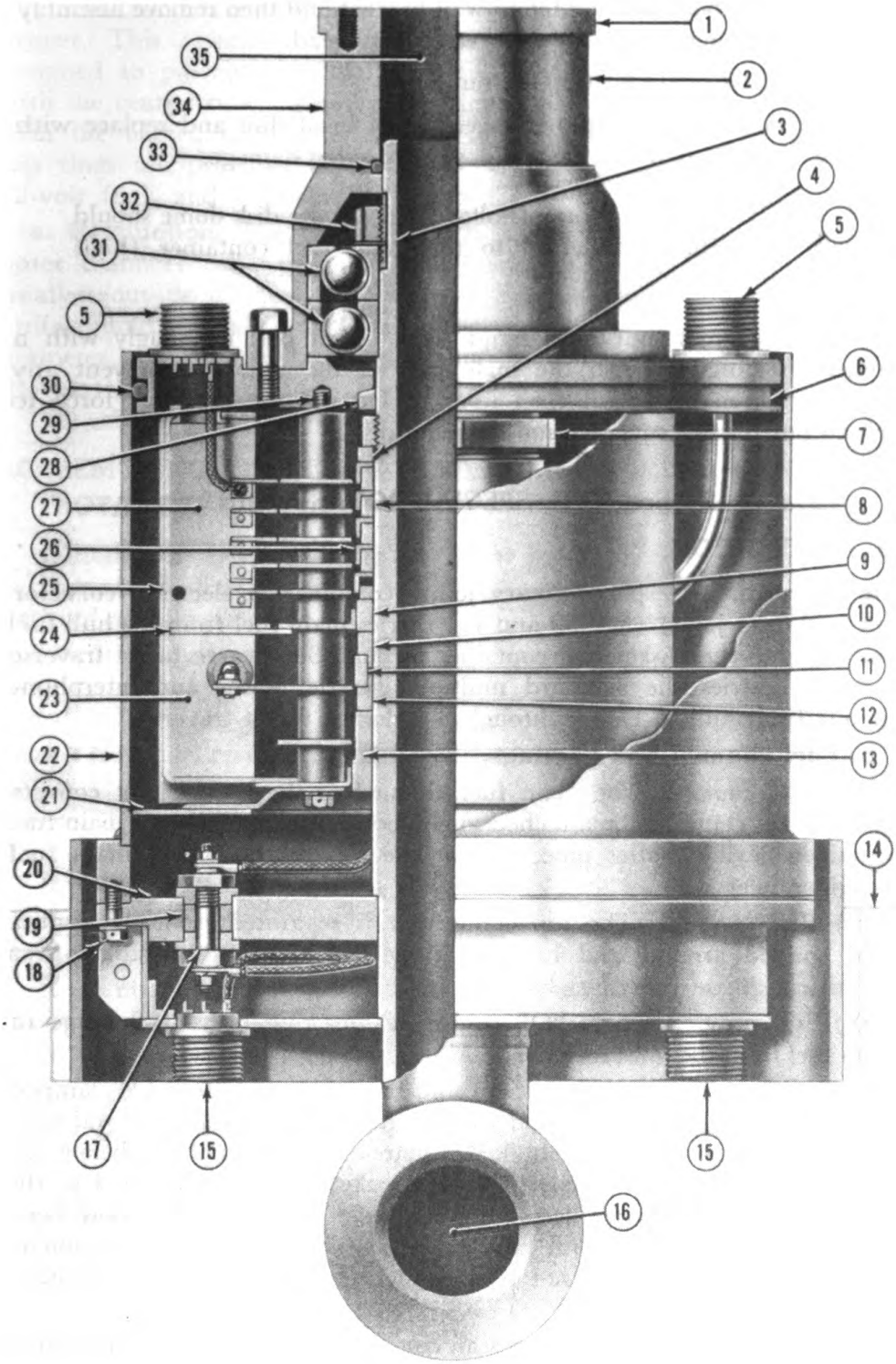


Figure 40—Special rotary joint (combination electrical collector ring and fluid joint) shown in cutaway view.

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(2) Remove bolts holding tee to wall bracket and then remove assembly consisting of swing check valve, tee, and safety head.

(3) Unscrew safety head union nut.

(4) Remove fractured or damaged safety head disk and replace with new disk. Handle new disk carefully, so as to avoid damage.

> CAUTION: The *concave* (hollow) side of the disk dome should face the piping connected to the main fuel container (high pressure side).

(5) Screw union nut until hand tight. Then pull up snugly with a wrench, holding back on the male part of the union to prevent any twisting motion of the disk on its seat. Do not use excessive force to tighten nut for this squeezes and damages disk.

Section XVII. SPECIAL ROTARY JOINT

39. DESCRIPTION.

a. General. The special rotary joint (combination electrical collector ring and fluid joint) (figs. 39 and 40) carries main fuel from the hull fuel containers to the basket fuel container through 360-degree turret traverse and also carries the standard multiple electric power and interphone circuits from hull to basket through 360-degree turret traverse.

b. Fuel channel and bearings.

(1) *Fuel channel.* The main fuel channel of the rotary joint consists of a vertical central tube attached at the bottom to the left hull main fuel container flexible outlet pipe, and at the top to the basket main fuel container inlet.

(2) *Ball bearings.* The top connection is separated from the central tube, guided around and held to it by ball bearings contained in a cylindrical grease (bearing) housing.

(3) *"O" ring.* A single "O" rubber sealing ring prevents leakage of main fuel from the joint into the housing.

c. Rotation. The top connections and the bearing housing are clamped to the basket fuel container and rotate with the basket. The central tube remains stationary with the hull. A square-ended "dumbbell" below the turret floor is retained loosely in square sockets, one socket bolted to the left hull main fuel container, the other welded outside the elbow bend at the bottom of the central tube. This "dumbbell" prevents rotation of the central tube but does not restrict slight tube movement horizontally or vertically.

d. Collector ring. The electrical collector ring consists of a slightly modified, standard medium tank collector ring assembly. The copper slip rings and spacers are slightly enlarged internally to slip over the central tube. The wiring (normally carried through the collector ring central tube) is carried in external slots in the tube wall of this modification.

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The standard brush and brush bracket assembly fits outside the slip rings proper. This assembly is submerged in a special cylindrical oil bath designed to prevent sparking. The oil bath housing remains stationary with the central tube, while the slip ring brushes and brush holders rotate with the basket, secured at the top to the bearing housing. Individual slip rings are provided to carry four interphone circuits, 24-volt feed, 12-volt feed, and a grounding connection from the hull to the basket.

e. Graduation. The central tube is graduated in steps of decreasing outer diameter from the bottom towards the top, the top having the smallest outside diameter. The internal bore of the central fuel tube is uniform and equivalent to 2-inch standard pipe size. The graduated outer diameter permits assembly of the complete rotary joint by placement of the parts in succession over the top of the central tube, bottom parts first.

40. REMOVING, SERVICING, AND DISASSEMBLING OF SPECIAL ROTARY JOINT.

a. Removal. If necessary to service or repair special rotary joint it is recommended that the entire joint be removed from turret. To do this proceed as follows:

(1) Unscrew nut holding flexible cables in cannon fittings on top of large cylindrical portion of joint in turret.

(2) Unbolt flange on fuel line leading from special rotary joint to basket main fuel container (FB-1 in Appendix, fig. 1).

(3) Unbolt flange at bottom of special rotary joint (below turret floor) connecting rotary joint with flexible hose connector from hull main fuel container (FH-2).

(4) Disconnect cable and wire connections in hull leading to bottom of collector ring assembly by unscrewing nut holding flexible cable in cannon fitting.

(5) Unbolt and remove bracket holding rotating part of joint to basket main fuel container (FB-1).

(6) Lift out entire special rotary joint through turret hatch.

b. Servicing fluid joint.

(1) Remove oil filling plug on top main housing flange of oil chamber and drain oil into a clean container by tipping upside down.

(2) Remove the hex head cap screws on the bottom of the oil chamber bottom plate.

(3) Lift off oil chamber housing.

(4) Remove eight outer bolts holding bottom flange of bearing housing to top main housing flange of oil chamber.

(5) Lift off bearing housing.

(6) Remove "O" rubber sealing ring from groove in upper part of bearing housing and replace, if damaged, with new ring. Lubricate ring (par. 28 b) before installing.

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c. Disassembling collector ring assembly. To disassemble collector ring assembly for servicing, carry out **a** and **b** above. Then proceed as follows:

(1) Remove lock ring on top of 2-inch standpipe (main fuel channel).

(2) Lift off the two thrust bearings.

(3) Remove main housing flange by unscrewing wired bolts extending through collector ring housing mounting plate.

(4) Remove split collector ring housing by unscrewing four nuts at base of collector ring.

(5) Disconnect the six wires leading to the brush holders (one 24-volt, one 12-volt, and 4 interphone circuits).

(6) Lift off main housing flange.

(7) Lift out brushes from brush holders (seven including ground wire).

(8) Lift off collector ring assembly. This assembly is a slightly modified, standard collector ring normally installed in the vehicle.

d. Removing collector rings.

(1) Loosen two socket head set screws in collector ring lock nut. Unscrew and lift off 2-inch standpipe.

(2) Disconnect wires from binding posts in oil chamber bottom plate (six wires).

(3) Lift off slip rings and insulating separators individually.

(4) The lowest ring (ground ring) requires heating to melt solder before it can be removed.

e. Reassembly. To reassemble special rotary joint, reverse procedures in **d**, **c**, and **b** above in this order. Refill oil chamber with oil (par. 24).

f. Installation. Reverse procedure in **a** above.

Section XVIII. PRESSURE SYSTEMS

41. GENERAL.

There are two pressure systems (figs. 41 and 43). Basically, both systems are made up of the same type of assemblies, namely, pressure containers, high pressure lines, pressure regulators, and lines containing reduced pressure, but details of construction and function are different. The two systems are:

a. Main pressure system, which holds the air or nitrogen used to propel the main fuel. It is located entirely within the hull and sponsons.

b. The auxiliary air pressure system located in the turret.

42. MAIN PRESSURE SYSTEM (HULL AND SPONSONS).

a. Description.

(1) *Pressure containers.* The pressure containers in the hull (fig. 41) consist of one dumbbell-shaped container (AH-1) located in the right sponson, four small cylindrical containers (AH-3, AH-4, AH-5, and

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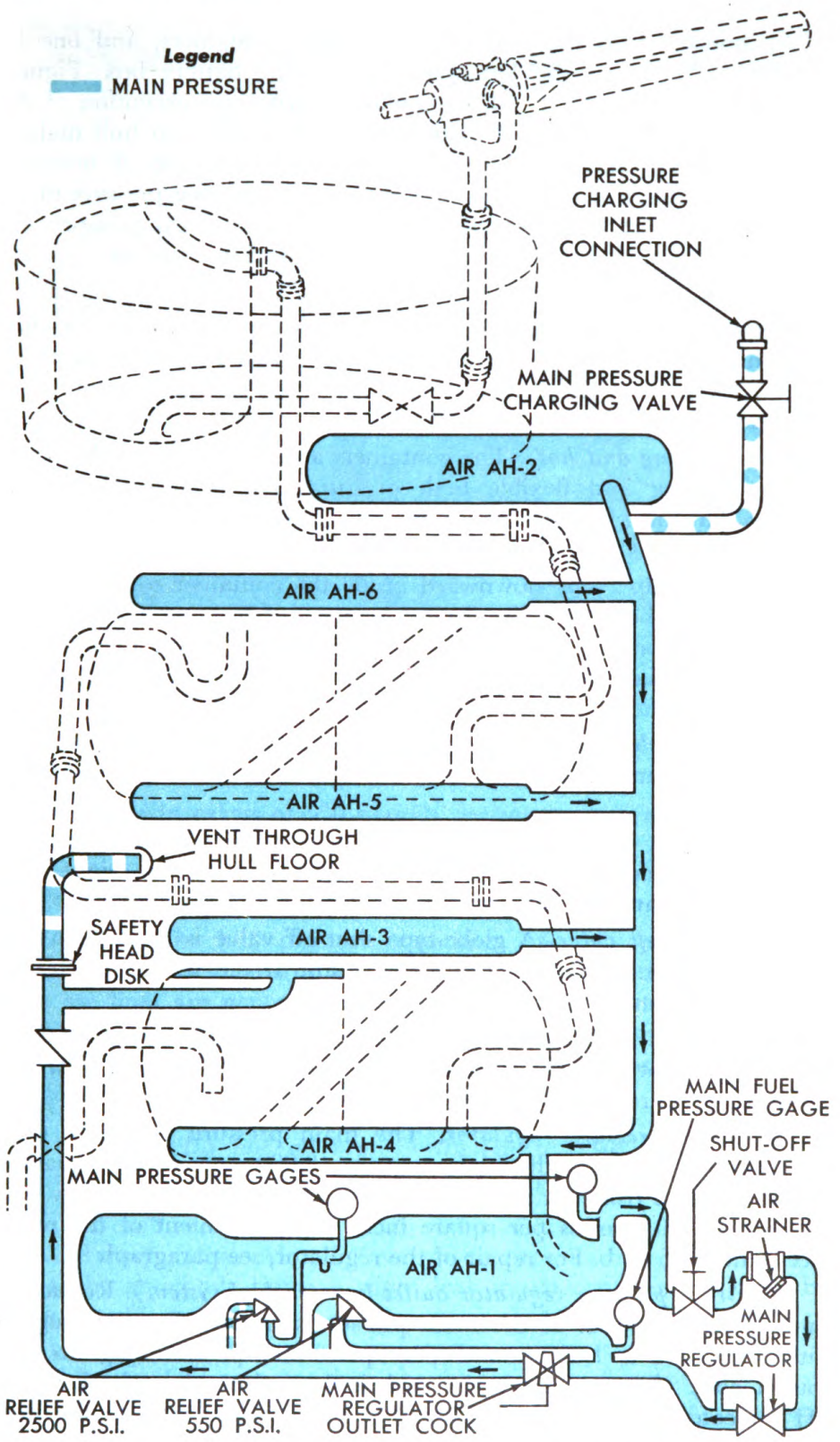


Figure 41—Flow diagram of main pressure system.

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AH-6) bracketed to the two hull main fuel containers, and one large container (AH-2) in the left sponson over the battery box. Figure 41 shows the general location of all containers with the exception of AH-4 and AH-5 which are located near the hull floor between hull main fuel containers FH-1 and FH-2. All pressure containers are of heavy steel construction designed to withstand the normal operating pressure of 2,000 pounds per square inch. Their function is to store high pressure air or nitrogen until needed to propel the fuel from the flame thrower.

(2) *High pressure lines.*

(a) Charging connection. The hull pressure containers are charged through a single charging connection and valve bracketed to the hull roof to the rear of the driver and adjacent to the left sponson pressure container (fig. 10).

(b) Tubing and hose. The containers are interconnected by means of seamless tubing and flexible high pressure reinforced synthetic rubber hoses so that the whole system is essentially a single reservoir.

(c) Water blow-out. The connection into each of the containers is carried in a "dip" pipe downward inside the container to within a short distance of the bottom. This provides a means of blowing out any accumulated water from the containers (by venting the main pressure system through the main pressure charging valve and pressure charging hose outside the vehicle).

(d) Air relief valve. The system is equipped with an air relief valve set at 2,500 pounds per square inch and located in the middle right sponson (fig. 42).

(e) Gages. Two main pressure gages (0 to 3,000 pounds per square inch) are included, one adjacent to the basket on the right sponson shelf (fig. 21) and the other at the assistant driver's position (fig. 20).

(f) Shut-off valve. A globe-type shut-off valve is located on the forward right sponson shelf beside the assistant driver, in the line leading to the main pressure regulator inlet.

(g) Strainer. In the line leading to main pressure regulator and ahead of the regulator inlet is an air strainer to remove dust and dirt, thereby protecting the regulator (fig. 11).

(3) *Main pressure regulator.* The main pressure regulator (fig. 11) automatically reduces the high pressure (2,000 pounds per square inch) air or nitrogen from the main pressure system to the constant low pressure of 375 to 400 pounds per square inch. For adjustment of the regulator, see paragraph 57 b. For repair of the regulator, see paragraph 93.

(4) *Main pressure regulator outlet line (to fuel system).* Reduced pressure from the outlet of the main pressure regulator flows through a tee fitted with a 0 to 1,000 pounds per square inch pressure gage to a 1-inch outlet cock (fig. 11). From the cock it flows through a check valve (fig. 41), located on the rear bulkhead, to the pressure inlet of the first hull main fuel container (FH-1). The regulator outlet line is also connected to an air relief valve on the right sponson shelf which automatically dis-

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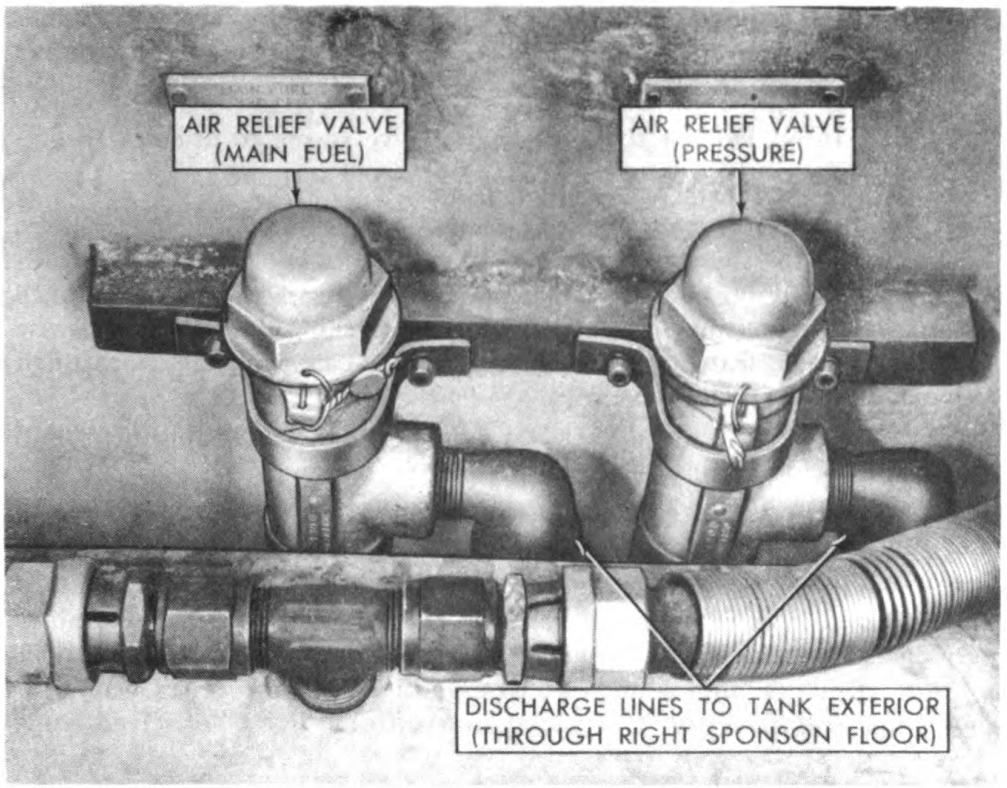


Figure 42—Air relief valves in right sponson.

charges pressure in excess of 550 pounds per square inch through sponson floor.

b. Maintenance of main pressure system.

(1) *General.* The hull pressure containers are not removable except by lifting off the entire turret. However, screwed connections in the high pressure air lines are generally accessible from the drivers' compartment or the basket and should be checked for tightness periodically. Tightness of joints may be checked by wiping joints with a soap and water mixture. Watch for bubbles while the system is under pressure.

> CAUTION: *Do not attempt to tighten screwed joints while system is under pressure. Release pressure, tighten joints, and then recharge system.*

(2) *Air relief valves.* Air relief valves on pressure systems are not required to be absolutely tight. A slight leak is not considered serious, but the leak should not permit a drop of more than 150 to 200 pounds per square inch in the 2,000 pounds per square inch system over a period of about 16 hours. This pressure drop should not be confused with a drop in pressure due to lowering of temperature (par. 57). In emergency, if leakage is excessive, release all main pressure, remove valve by unscrewing it from its fittings, and replace it with a new one having the proper setting, for

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example, 2,500 pounds per square inch for main pressure, and 550 pounds per square inch for main fuel pressure. Return defective valve to higher echelon for repair, and resetting.

CAUTION: Do not screw down on valve spring to attempt to stop leak.

(3) *Main pressure charging and main pressure regulator inlet valves.* Leaks around the stems of these valves can usually be corrected by screwing down slightly on packing nut of the stem, using a wrench. If leakage persists, release pressure from system, remove packing nut, and insert new packing. If valve seat has been damaged as indicated by leakage through valve, replace with new valve.

(4) *Main pressure regulator.* See paragraph 57 for adjustment and paragraph 93 for repair of main air pressure regulator.

(5) *Main pressure regulator outlet cock* (fig. 11). Keep lubricated with stick lubricant (Nordstrom No. 147) which is supplied with flame thrower to assure a tight valve and ease of operation.

(6) *Air screen.* This screen should be removed from the strainer periodically and cleaned to prevent damage to or plugging of the main pressure regulator and assure free passage of air or nitrogen. Clean with motor fuel and blow dry. To remove, unscrew plug in "Y" of screen body.

43. AUXILIARY AIR PRESSURE SYSTEM.

a. Description. The auxiliary air pressure system (in the turret) (fig. 43) supplies pressure for actuation (operation) of flame gun, for the secondary fuel system, for the atomizer fuel system, and for the atomizer air system.

(1) *Basket auxiliary pressure container.* This heavy-walled steel container rests vertically on the basket floor. It has one connection on top through which high pressure air is charged or vented. This connection, extending inside to within a short distance of the bottom of the container, serves also as a means by which any accumulated water in the container can be blown out through the charging line by rapid venting of the air to the turret exterior.

(2) *Charging line.* The charging connection is located outside the turret roof in a protected well (fig. 24) together with other charging connections. The auxiliary air charging valve is located in the charging line inside the turret.

(3) *Air relief valve and pressure gage.* An air relief valve set for 2,500 pounds per square inch is provided on the high pressure line to prevent build-up of pressure in the container above this amount. The relief valve is located to the rear of the regulator panel board in the left turret. The discharge from this valve is led outside the turret through a hole in the left rear turret shelf. A 3,000 pounds per square inch gage is mounted in front of the gunner and indicates the pressure in the auxiliary air system.

(4) *High pressure line.* The high pressure line from the auxiliary

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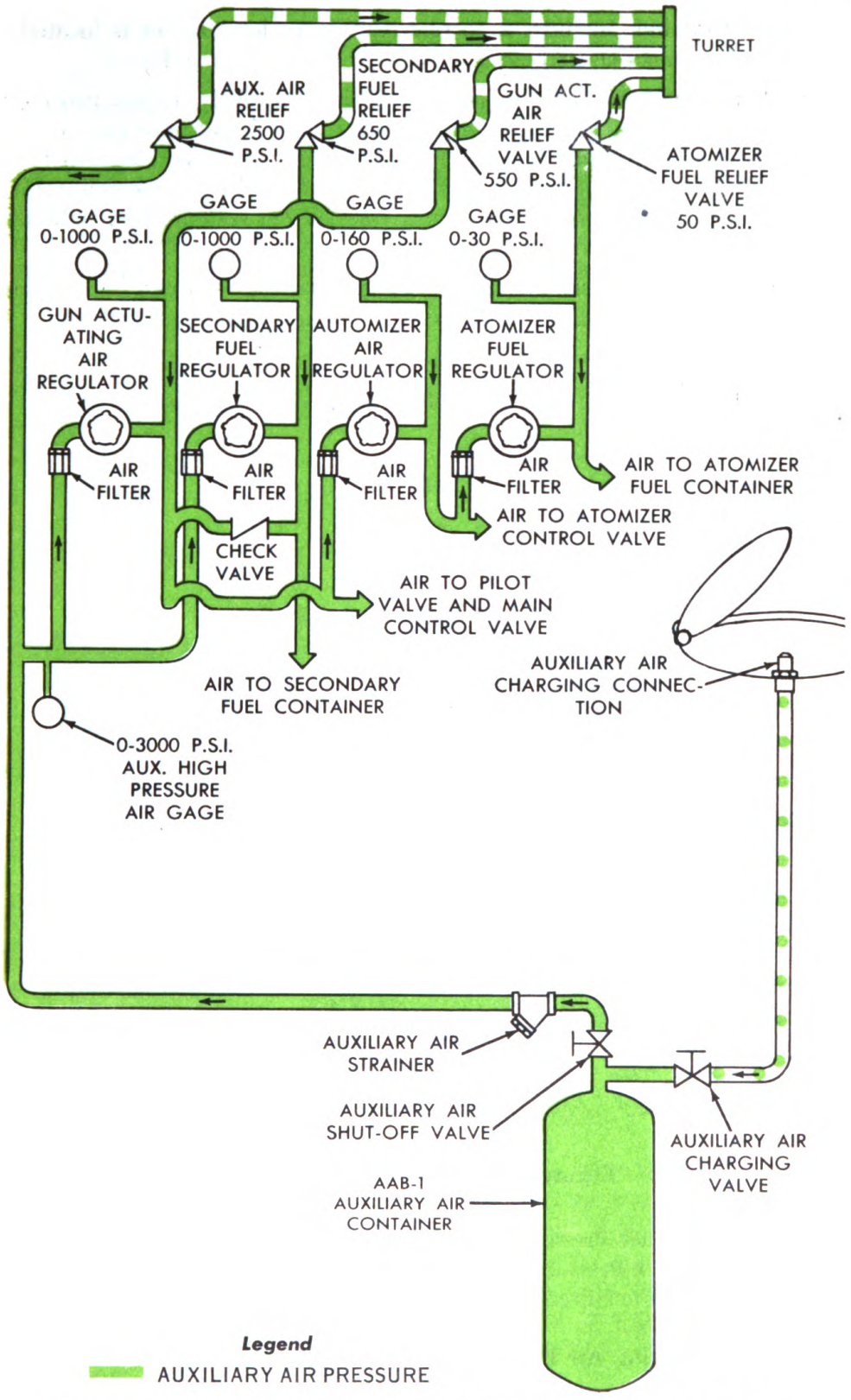


Figure 43—Flow diagram of auxiliary air pressure system.

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pressure container includes a ½-inch valve. An air strainer is located in the line to clean the air before it passes through the regulators.

b. Maintenance. If air relief valve leaks excessively, follow procedure given in paragraph 42 b (2) on air relief valves. If pressure gage is damaged or does not read correctly, replace with a new gage. Return faulty gage to higher echelon for repair. Correct leaks in hose or pipe connections, or around valve stems, by releasing pressure from system, then tightening connections or repacking valve stems.

c. Removal of basket auxiliary air pressure container. If necessary to replace basket auxiliary air pressure container, proceed as follows:

(1) Release all pressure in system.

(2) Disconnect lines leading to container.

(3) Unbolt brackets.

(4) Lift container out through turret hatch.

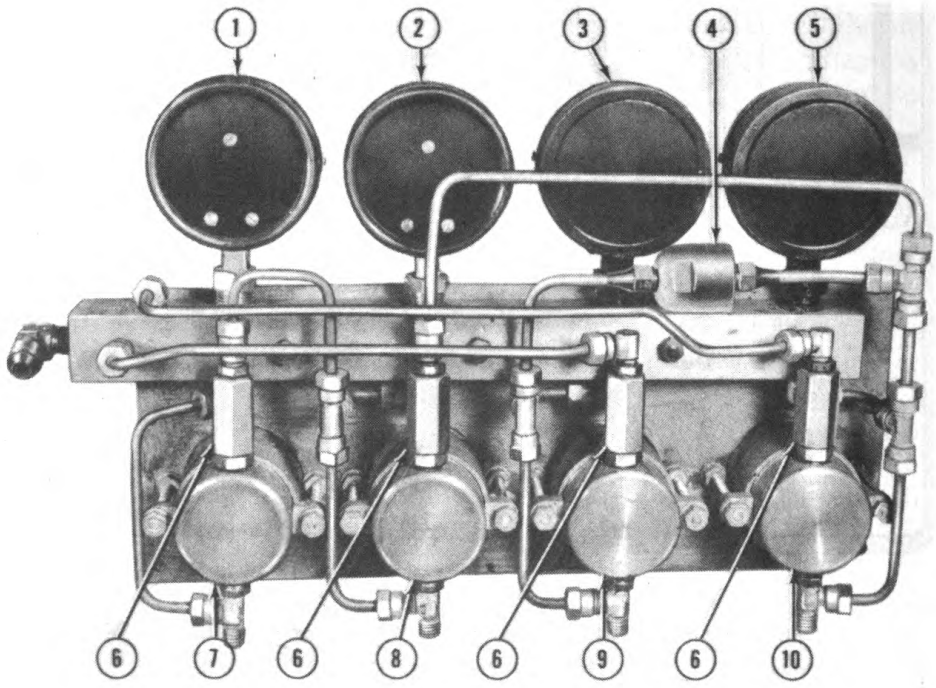


Figure 44—Rear of panel board.

1. Atomizer Fuel Pressure Gage
2. Atomizer Air Pressure Gage
3. Secondary Fuel Pressure Gage
4. Check Valve
5. Gun Actuating Air Pressure Gage
6. Air Filter
7. Atomizer Fuel Pressure Regulator
8. Atomizer Air Pressure Regulator
9. Secondary Fuel Pressure Regulator
10. Gun Actuating Air Pressure Regulator

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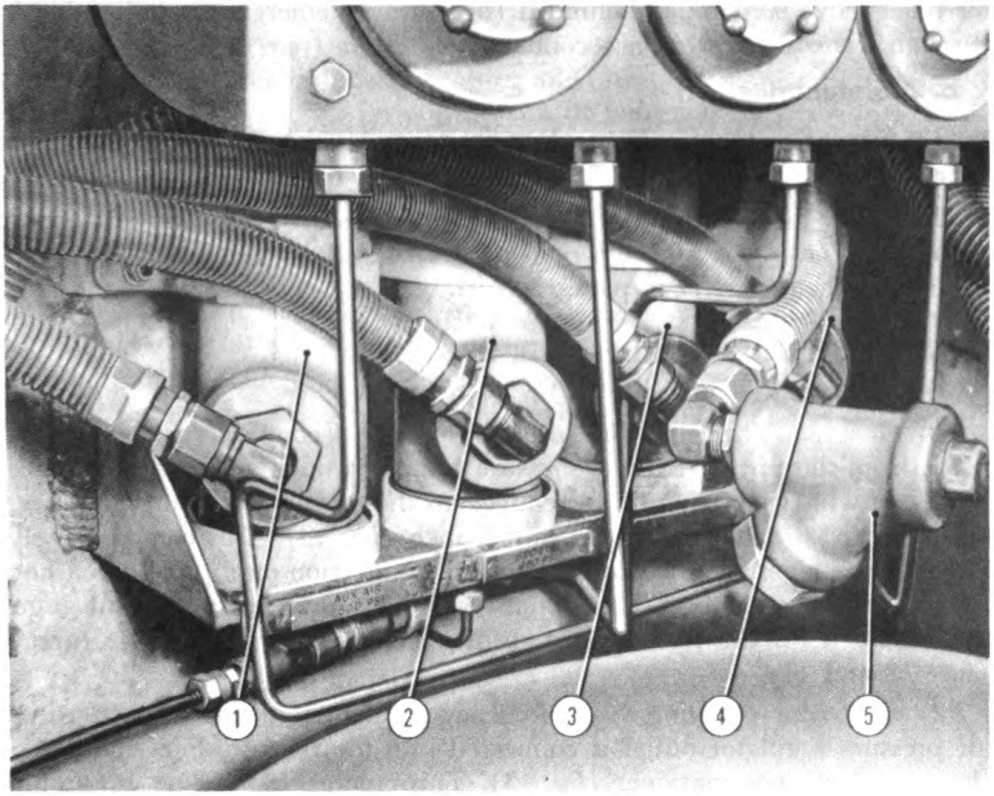


Figure 45—Air relief valves in turret.

1. Auxiliary Air Pressure Relief Valve, 2500 P.S.I.
2. Secondary Fuel Pressure Relief Valve, 650 P.S.I.
3. Gun Actuating Air Pressure Relief Valve, 550 P.S.I.
4. Atomizer Fuel Pressure Relief Valve, 50 P.S.I.
5. Auxiliary Air Strainer

d. Installation of basket auxiliary air pressure container. To install, reverse above procedure and use wrenches to make sure connections are tight.

44. GUN ACTUATING AIR SYSTEM.

a. Description. The gun actuating air is taken from the 2,000 pounds per square inch turret auxiliary air pressure system and passes through the gun actuating air pressure regulator (with gage), where it is reduced to a pressure (375 to 400 pounds per square inch) equal to main fuel pressure (fig. 43). This comparatively low pressure air is then led to the main control valve located on top of the flame gun. An air relief valve set at 550 pounds per square inch prevents this system from being overloaded. The pressure regulator and gage for this line are mounted on the panel board suspended from the roof of the turret (figs. 19 and 44) and the

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air relief valve is mounted behind it (fig. 45). An emergency air line leads through a check valve to the secondary fuel system (par. 45).

b. Maintenance.

(1) *Gun.* For maintenance of main control valve on flame gun, see paragraph 63.

(2) *Pressure regulator.* For adjustment of pressure regulator, see paragraph 58. For repair of pressure regulator, which is normally a function of higher echelons, refer to paragraph 94.

45. AIR FOR SECONDARY FUEL SYSTEM.

a. Description.

(1) *General.* The high pressure air for the secondary fuel system is taken from the turret auxiliary pressure system through a separate pressure regulator with gage where it is reduced to the normal operating pressure, which is 520 to 540 pounds per square inch (fig. 43). This comparatively low pressure air is then led to the pressure connection on top of the basket secondary fuel container. The secondary fuel pressure regulator and gage are mounted on the panel board suspended from the roof of the turret (figs. 19 and 44).

(2) *Emergency air line.* An emergency air line from the gun-actuating air pressure regulator outlet is connected into the pressure line leading to the secondary fuel container (fig. 43). This emergency air line automatically supplies air if normal flow of high pressure air for the secondary fuel drops below the gun actuating air pressure. This air is brought in through a check valve and line to a tee in the air system for secondary fuel behind the panel board.

(3) *Air relief valve* (fig. 45). An air relief valve set at 650 pounds per square inch is provided in this system on the pressure regulator outlet of the air system for the secondary fuel. This relief valve is located behind the regulator panel board in the turret. A line from the basket secondary fuel container leads through this relief valve out the left rear turret shelf to the outside of the turret.

b. Maintenance.

(1) *Relief valve.* See subparagraph 42 b (2).

(2) *Leaks.* Check connections for tightness.

(3) *Pressure regulator.* For adjustment of pressure regulator, see paragraph 58. For repair of pressure regulator, which is normally a function of higher echelons, refer to paragraph 94.

46. ATOMIZER AIR SYSTEM.

a. Description (fig. 43). Air from the outlet of the gun actuating air pressure regulator is connected to the atomizer air pressure regulator and its gage, mounted on the panel board (figs. 19 and 44). The outlet of this regulator provides 75 to 80 pounds per square inch of air to the air inlet of the atomizer valve.

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b. Maintenance.

(1) *Leaks.* Check tightness of tubing and hose connections.

(2) *Pressure regulator.* For adjustment of pressure, see paragraph 59. For repair of pressure regulator, which is normally a function of higher echelons, refer to paragraph 95.

47. AIR FOR ATOMIZER FUEL SYSTEM.

a. Description (fig. 43). Air from the outlet of the atomizer air pressure regulator is led to the atomizer fuel pressure regulator and gage mounted on the panel board (figs. 19 and 44). The outlet of this regulator provides 7 to 8 pounds per square inch of air to the air inlet connection on the basket atomizer fuel container (par. 52 d). An air relief valve set at 50 pounds per square inch is provided in this system, the discharge line from this relief valve leading through the left rear turret shelf to the outside of the turret.

b. Maintenance.

(1) *Leaks.* Check tightness of tubing connections.

(2) *Pressure regulator.* For adjustment of pressure regulator, see paragraph 59. For repair of pressure regulator, which is normally a function of higher echelons, refer to paragraph 95.

Section XIX. SECONDARY FUEL SYSTEM

48. DESCRIPTION.

Secondary fuel serves to improve ignition of the main thickened fuel stream or "rod" as it issues from the gun, particularly when operating at low temperatures or in high velocity cross winds. This improved fuel ignition in the air normally increases range. Moreover, the large and "live" flame in flight adds to the terrifying effect on the enemy. Motor fuel or gasoline (without thickener) is recommended for use as secondary fuel since this is easily ignited under adverse weather conditions.

a. Secondary fuel container. Secondary fuel is carried in a single vertical container (figs. 35 and 46) which has approximately 12 gallons capacity. It is located on the basket floor at the left side of the turret.

b. Outlet. A top outlet leads from the secondary fuel container through a valve and strainer to the main control valve on the flame gun. This outlet line extends to within ½-inch of the bottom of the container.

c. Filling pipe. The container is filled through a ½-inch line leading from a protected well (dummy periscope cover) in the turret roof (fig. 24).

d. Air inlet. A third connection in the basket secondary fuel container serves as an air inlet. The air for supplying pressure comes from the discharge side of the secondary fuel pressure regulator into the top of the container. A take-off from this line leads to an air relief valve set at 650 pounds per square inch, located on the left turret wall. The discharge side of the valve releases pressure to the outside of the turret.

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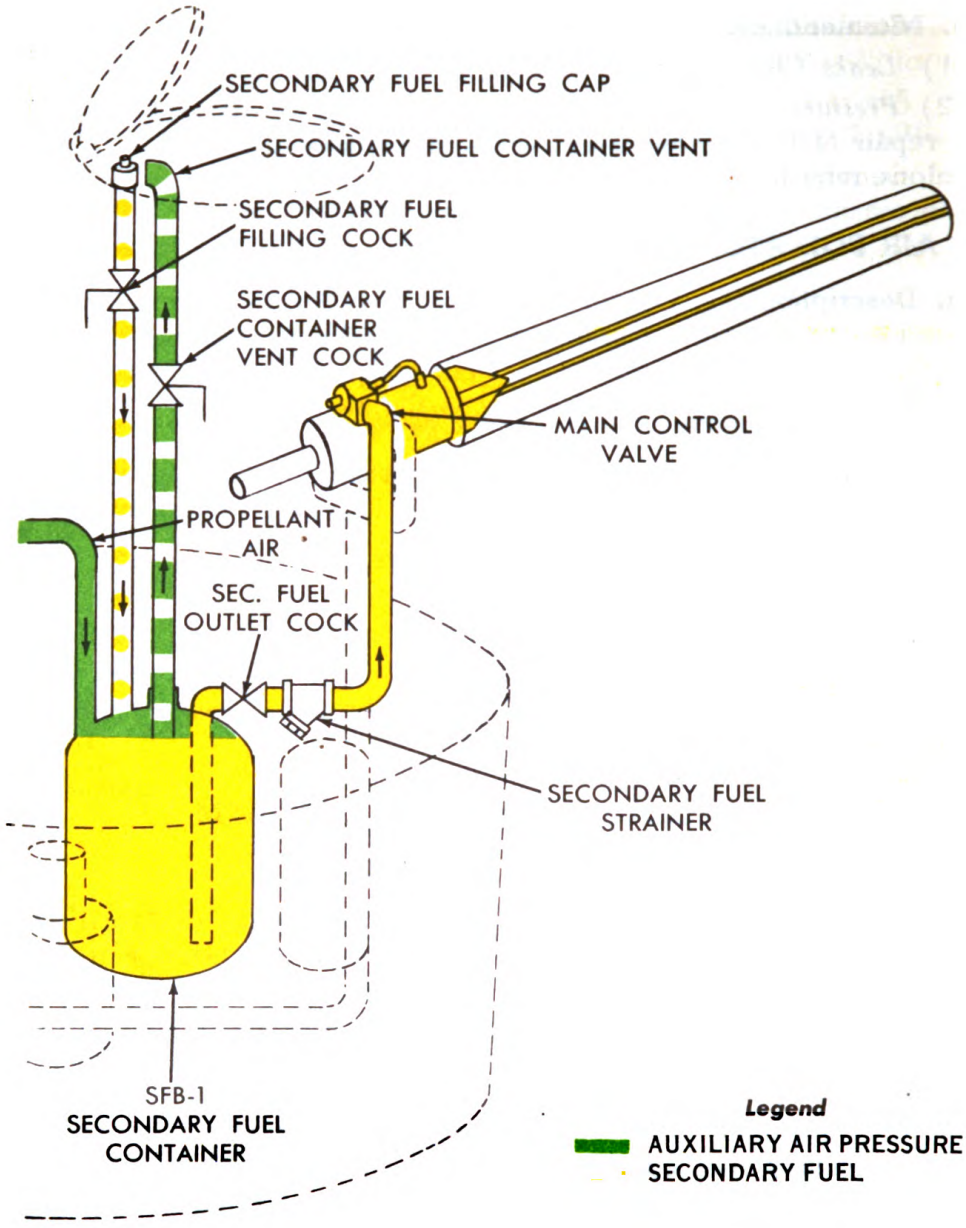


Figure 46—Flow diagram of secondary fuel system.

e. Vent line. The vent line enters the container through the top and extends down into the container about 2 inches. This prevents filling the container above this level and allows about 5 percent void space for expansion of the secondary fuel. The vent line leads outside the turret into the roof well to carry away fume-laden air when venting the container.

49. MAINTENANCE OF SECONDARY FUEL SYSTEM.

a. Tubing and hose connections. Check connections for tightness periodically.

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b. Strainer. Remove and clean fuel strainer periodically to assure full flow of clean fuel.

c. Air relief valve. If relief valve leaks excessively, replace with new valve and send faulty one to higher echelon for repair and readjustment.

d. Secondary fuel leak in gun. If leaks are encountered in flame gun, service main control valve as described in paragraph 63 d.

50. REMOVAL OF BASKET SECONDARY FUEL SYSTEM.

a. Fuel removal. Before attempting removal of the secondary fuel container, empty it of fuel in the following manner:

(1) Start turret ventilator fan to circulate air in turret.

(2) Close secondary fuel outlet cock (par. 10 d (5)) and vent pressure from secondary fuel system until secondary fuel pressure gage reads 50 to 75 pounds per square inch. Close vent cock.

(3) Disconnect secondary fuel outlet hose connection at the main control valve.

(4) Insert hose into an empty 5-gallon can and slowly open secondary fuel outlet cock. The secondary fuel should flow out under pressure into the can.

(5) If the can is filled before secondary fuel system is emptied, shut the outlet cock and substitute another empty can.

(6) Proceed as above until no further fuel flows from line. Then close outlet cock and vent remainder of pressure in system by opening secondary fuel vent cock.

> CAUTION: A small amount of secondary fuel still remains in the container after this operation. This must be emptied after the container is removed by turning it upside down and draining through air inlet connection. The container *must* then be flushed out with water or steamed out thoroughly before repairing the vessel.

b. Basket secondary fuel container removal.

(1) Remove all fuel from container as described in **a** above.

(2) To remove container, disconnect tubing and hose connections on top of container.

(3) Remove bolts in brackets which hold container to turret basket supports.

(4) Lift container out through turret hatch.

51. INSTALLATION OF BASKET SECONDARY FUEL CONTAINER.

To install, reverse procedure in paragraph 50 above.

Section XX. ATOMIZER FUEL SYSTEM

52. DESCRIPTION.

The atomizer fuel system (fig. 47) supplies clean, dry motor fuel or gasoline (without thickener) to the atomizer nozzle for the ignition flame.

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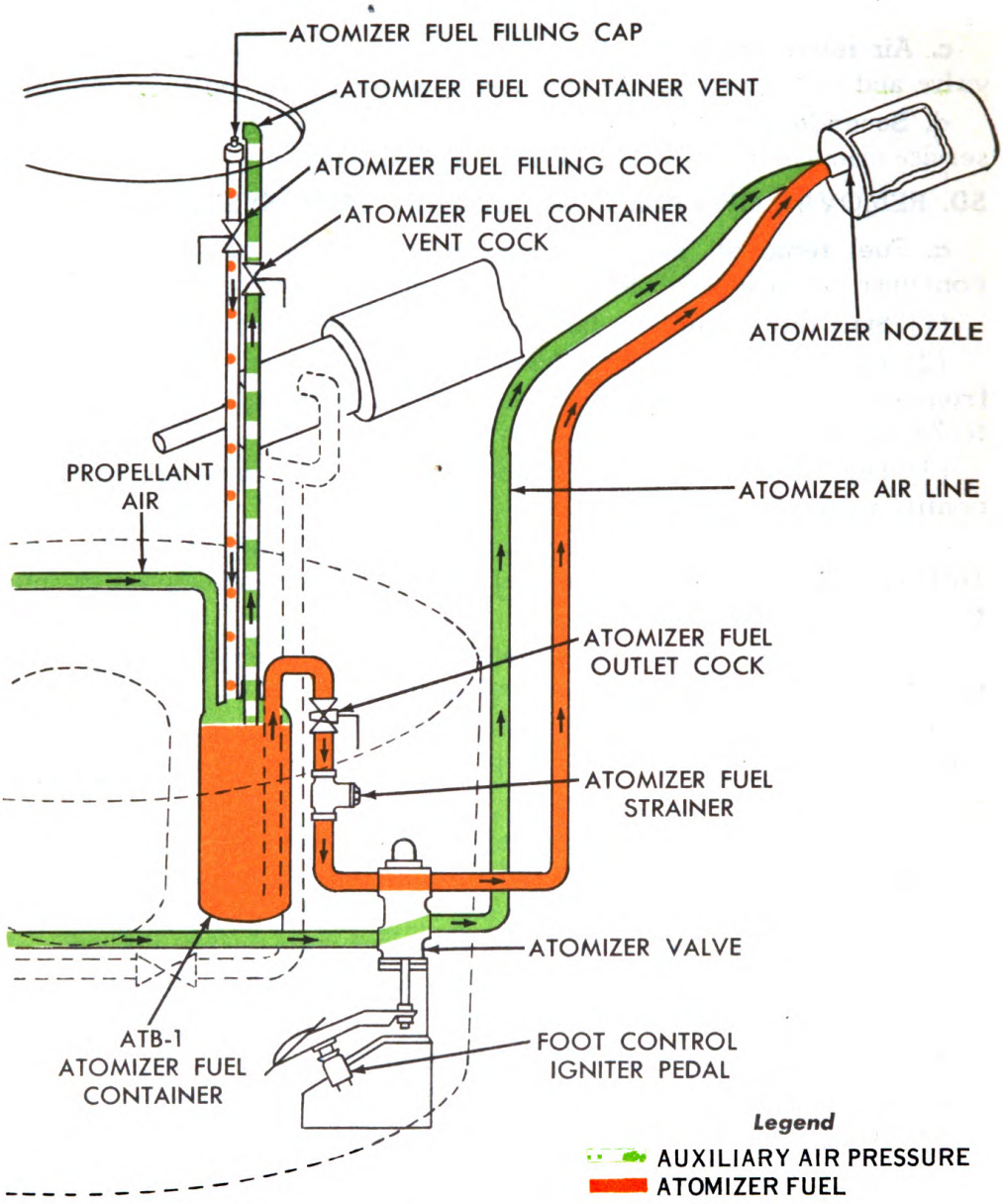


Figure 47—Flow diagram of atomizer fuel system.

a. Atomizer fuel container. Atomizer fuel is held in a single small container (fig. 35) having capacity of approximately 2 gallons. It is located forward of the basket secondary fuel container and stands vertically on the left side of the turret floor.

b. Outlet. A top outlet leads from the container through a shut-off valve to a fine strainer at the gasoline inlet of the atomizer valve on the turret floor. This outlet extends inside the container to a point ½-inch above the bottom. Contents of the container can be drained through the

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outlet line by closing the filling and vent cocks, then applying low air pressure through the atomizer fuel pressure regulator.

c. Filling pipe. The container is filled from outside the turret through a ½-inch connection in the protected roof well (fig. 24). The filling pipe extends to the top of the basket atomizer fuel container.

d. Air inlet. The third connection in the container carries an air inlet from the discharge side of the atomizer fuel pressure regulator. This air inlet is also connected to an air relief valve set for 50 pounds per square inch, located on the left turret wall. The relief valve discharges outside the turret.

e. Vent line. The fourth connection in the container extends about 1½ inches into the container from the top. It serves as a vent outlet. This prevents filling of the container above this level and allows approximately 5 percent void space for expansion of atomizer fuel. The vent line leads outside the turret into the roof well to carry away gasoline-laden air when venting the container. It serves as an overflow line during filling to indicate when container is fully filled.

53. REMOVAL OF BASKET ATOMIZER FUEL CONTAINER.

To remove basket atomizer fuel container, follow procedure outlined in paragraph 50 for the basket secondary fuel container.

54. INSTALLATION OF BASKET ATOMIZER FUEL CONTAINER.

To install container, reverse procedure used in paragraph 53.

55. MAINTENANCE OF ATOMIZER FUEL SYSTEM.

a. Tubing and hose connections. Check periodically for tightness.

b. Strainer. Clean strainer periodically.

c. Air relief valve. If excessive leakage occurs, replace valve and return faulty one to higher echelon for repair and resetting.

d. Leakage in atomizer valve. To correct leakage of fuel through atomizer valve, follow procedure in paragraph 65 d.

Section XXI. PRESSURE REGULATORS

56. GENERAL.

The purpose of pressure regulators is to reduce the variable high pressure of air or nitrogen to a reduced regulated pressure, and to maintain this regulated outlet pressure constant even with changing inlet pressure or varying flow. The flame thrower includes five regulators of different sizes and capacities. One regulator is a part of each of the following pressure systems:

a. Main pressure (Grove dome type).

b. Secondary fuel air (Grove spring-loaded type 15-H).

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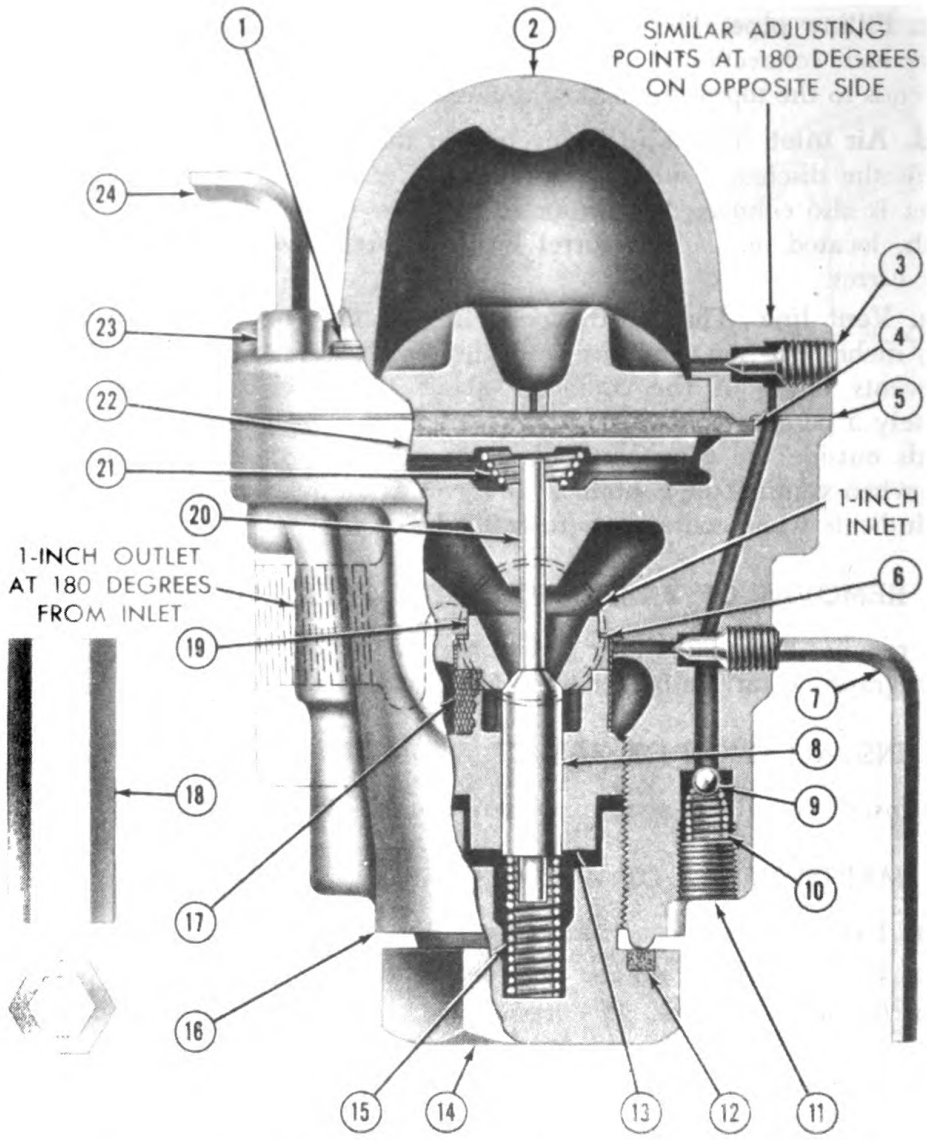


Figure 48—Main pressure regulator (sectional view).

c. Gun actuating air (Grove spring-loaded type 15-H).

d. Atomizer air (Grove spring-loaded type 15).

e. Atomizer fuel air (Grove spring-loaded type 15).

57. MAIN PRESSURE REGULATOR.

a. Description. The main pressure regulator, shown in figs. 11 and 48, is of the dome type. The diaphragm is pressure loaded instead of spring loaded. The desired regulated pressure is obtained by an adjustment which admits pressure (from the inlet pressure port through a loading valve) to

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Legend for Figure 48

1. Jackscrew
2. Dome
3. Needle Valve
4. Diaphragm
5. Dome Gasket
6. Valve Seat Gasket
7. Loading Wrench
8. Valve
9. Relief Ball
10. Relief Spring
11. Relief Screw
12. Body Plug Gasket
13. Seat Bushing
14. Body Plug
15. Valve Spring
16. Body
17. Strainer
18. Bushing Wrench
19. Valve Seat
20. Pushrod
21. Diaphragm Spring
22. Diaphragm Plate
23. Capscrew
24. Capscrew Wrench

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the dome of the regulator where needle valves seal off the pressure over the diaphragm. Repair of the regulator is described in paragraph 93.

> Note: Temperature changes in the air or nitrogen in the dome produced by changes in atmospheric temperature produce a slight change in the regulated pressure. This change amounts to about 1 percent of the reduced absolute pressure for each 5 degrees F. change in temperature. An increase in temperature raises dome or regulated pressure. A decrease in temperature lowers dome or regulated pressure. Under extreme temperature variation, readjustment of the regulator is required.

b. Adjustment. To put the pressure regulator (fig. 48) in operation or to adjust it, it is necessary to charge the dome with a pressure equal to the desired outlet pressure. To do this, proceed as follows:

(1) Close the 1-inch shut-off cock in the outlet line from the regulator. Slowly open the main pressure inlet valve on the inlet side of the regulator.

(2) Insert socket head screw wrench in side body needle valve and open one-quarter to one-half turn.

> Note: This is the upper side needle valve in the E12-7R1 mechanized flame thrower because the regulator is installed in inverted position (fig. 11) (reverse position of that shown in figure 48).

(3) Insert socket head screw wrench in dome needle valve (3) (fig. 48) and open slowly, watching the 0 to 1,000 pound gage on outlet side of regulator.

(4) When desired pressure is shown on gage, close dome needle valve tightly and then close body needle valve.

(5) If outlet pressure is too high, close the main pressure regulator valve and then open very slightly the 1-inch shut-off cock in the discharge line from the regulator. Then open dome needle valve with socket head

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Legend for Figure 49

1. Cap Nut
2. Relief Screw Washer
3. Relief Locking Spring
4. Relief Adjusting Screw
5. Spring Barrel
6. Handwheel
7. Thrust Bearing
8. Guide Button
9. Guide Button Screw
10. Stem
11. Loader Spring
12. Stop Nut
13. Sleeve
14. Relief Seat Retainer
15. Diaphragm Bolt
16. Clamping Ring
17. Diaphragm
18. Diaphragm Plate
19. Diaphragm Nut
20. Valve Seat
21. Valve Follower
22. Body
23. Valve Spring
24. Valve
25. Valve Pin
26. Inlet Seat Retainer
27. Gasket
28. Diaphragm Protector
29. Mounting Nut
30. Mounting Screw Washer
31. Mounting Plate
32. Mounting Screw
33. Relief Stem
34. Nut

screw wrench, letting dome pressure leak out past needle valve thread. Close 1-inch shut-off cock and repeat steps (1) through (4) above.

(6) When the regulator outlet gage indicates the desired pressure setting, open the main regulator outlet cock very slightly and then close the cock after a second or less, with the inlet valve open, and observe the outlet gage reading. This equalizes the pressure under flow conditions on each side of the diaphragm in the regulator. Readjust the regulator to give the desired outlet pressure on the basis of the indicated outlet pressure after permitting air flow.

(7) If the atmospheric temperature has changed greatly since the last previous adjustment, close main pressure regulator inlet valve and then readjust up or down as necessary.

58. SECONDARY FUEL PRESSURE AND GUN ACTUATING AIR PRESSURE REGULATORS.

a. Description.

(1) The secondary fuel pressure and gun actuating air pressure regulators are Grove Model 15-H (3,500 pounds per square inch maximum inlet pressure), spring-loaded type (fig. 49). They are located on the turret regulator panel board (figs. 19 and 44).

> CAUTION: Do not substitute Grove Model 15 regulator (used on atomizer air and atomizer fuel systems) because this model is built for only 1,000 pounds per square inch maximum inlet pressure.

(2) The 15-H type of regulator is a spring and diaphragm operated

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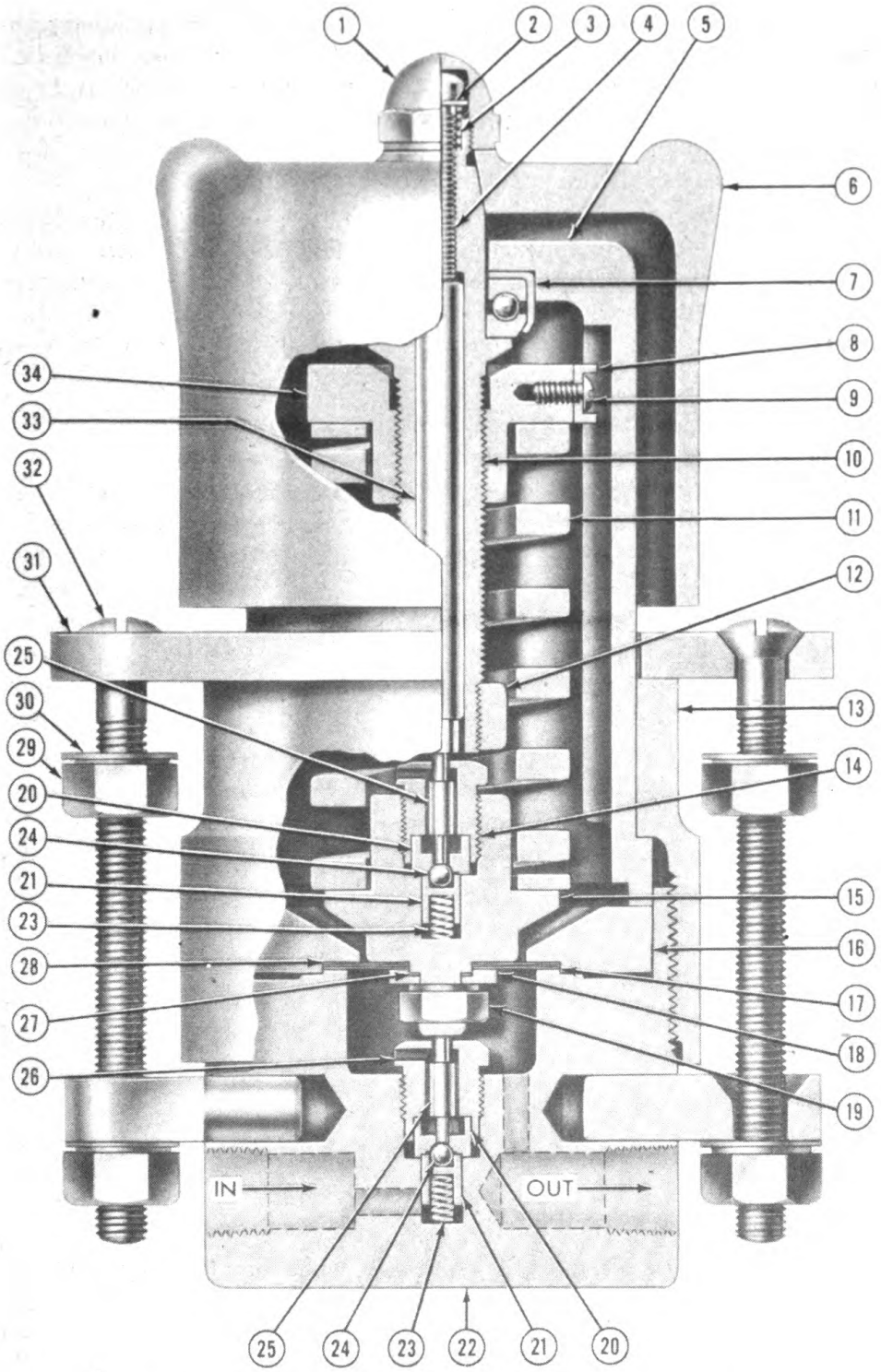


Figure 49—Secondary fuel pressure air pressure regulator (sectional view). (Gun actuating air pressure regulator is similar.)

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unit. Both the secondary fuel pressure and gun-actuating air pressure regulators have loader springs for the range of 200 to 1,000 pounds per square inch controlled outlet pressure. When the manually operated handwheel increases tension on the spring (by turning handwheel clockwise), the inlet valve is forced from its seat, admitting pressure to the diaphragm chamber and outlet line. When this pressure on the diaphragm produces a force equal to the adjusted spring tension, the diaphragm rises, closing the inlet valve.

(3) When the spring tension is reduced, pressure in the diaphragm chamber acting on the diaphragm is greater than the spring force, and the diaphragm assembly, including relief valve seat, rises, allowing the projection on the handwheel stem to open the relief valve. This allows excessive pressure to escape from the system through the relief valve. When the spring force balances the diaphragm chamber pressure, the relief valve is closed.

b. Adjustment.

(1) To increase regulated pressure, turn handwheel (6) (fig. 49) clockwise, watching pressure gage on panel above regulator, until desired pressure is reached. To decrease regulated pressure, turn handwheel counterclockwise until gage reads desired pressure. This second operation will be accompanied by the sound of escaping air from the built-in regulator relief valve. The sound of escaping air does not indicate a leak in the system unless it persists. Because of the volume of air in the secondary fuel system, a few minutes is required before the system reaches the reduced regulator outlet pressure.

(2) A second adjustment comprises a screw (4) under the cap (1) nut on handwheel which controls the operation of the built-in relief valve. It is normally not necessary to touch this second adjustment. In the event it is necessary to readjust, proceed as follows:

(a) Set handwheel of regulator for desired operating pressure.

(b) With screw driver turn adjustment screw (4) under cap or "acorn" nut clockwise until slight audible leak is detected through relief valve.

(c) Turn adjustment screw (4) slowly counterclockwise until leak can no longer be heard.

(d) Next turn adjustment screw counterclockwise one-half turn more and leave in this position.

c. Maintenance.

(1) If regulator fails to deliver pressure when handwheel is adjusted, check pressure supply by slightly loosening tubing connector at inlet filter. If pressure is available at this point, shut off pressure supply, disassemble filter, and clean.

(2) If valves leak, check adjustment screw by resetting adjustment screw as in **b** above. If leak persists, tighten adjustment screw. This will

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cause relief valve to open and blow out scale or dirt. Then readjust. Replace valves or valve seats if necessary (par. 94).

d. Inlet filter checking. The regulators are equipped with a small external inlet filter for cleaning the air passing through the regulator (fig. 44). The filter should be cleaned periodically, as follows:

(1) Disconnect inlet connection to filter and unscrew filter from regulator inlet.

(2) Using two wrenches, unscrew filter cap from body.

(3) Unscrew filter case and remove felt filter element and screen.

(4) Wash felt filter element and screen in motor fuel to remove dirt. Blow dry.

(5) Assemble, reversing above procedure.

59. ATOMIZER AIR PRESSURE AND ATOMIZER FUEL PRESSURE REGULATORS.

a. Description. The atomizer air pressure and fuel pressure regulators are Grove Model 15 (1,000 pounds per square inch maximum inlet pressure) spring-loaded type (fig. 50). They are located on the panel board shown in figures 19 and 44. In principle of operation, they are the same as the secondary fuel and gun actuating air pressure regulators (par. 58).

> CAUTION: These regulators should not be used in the secondary fuel or gun actuating air system because they are not built for the high pressure (2,000 pounds per square inch) existing at the inlet of these systems. The atomizer air pressure regulator has a loader spring with a range for 5 to 150 pounds per square inch controlled outlet pressure, but the atomizer fuel pressure regulator has one for ½ to 25 pounds per square inch range only. Some parts of Model 15 regulator differ from those in Model 15-H.

b. Adjustment of regulator. Procedure is similar to that for Model 15-H (par. 58 b).

c. Maintenance.

(1) If regulator fails to deliver pressure when handwheel is adjusted, check pressure supply by slightly loosening tubing connector at inlet filter. If pressure is available at this point, shut off pressure supply, disassemble filter, and clean.

(2) If valves leak, check adjustment screw by resetting adjustment screw as in **b** above. If leak persists, tighten adjustment screw. This will cause relief valve to open and blow out scale or dirt. Then readjust. Replace valve or valve seats if necessary (par. 95).

d. Inlet filter. See paragraph 58 d.

Section XXII. E7R1 MECHANIZED FLAME THROWER GUN

60. DESCRIPTION.

a. The flame thrower gun is air operated. It includes a remote-

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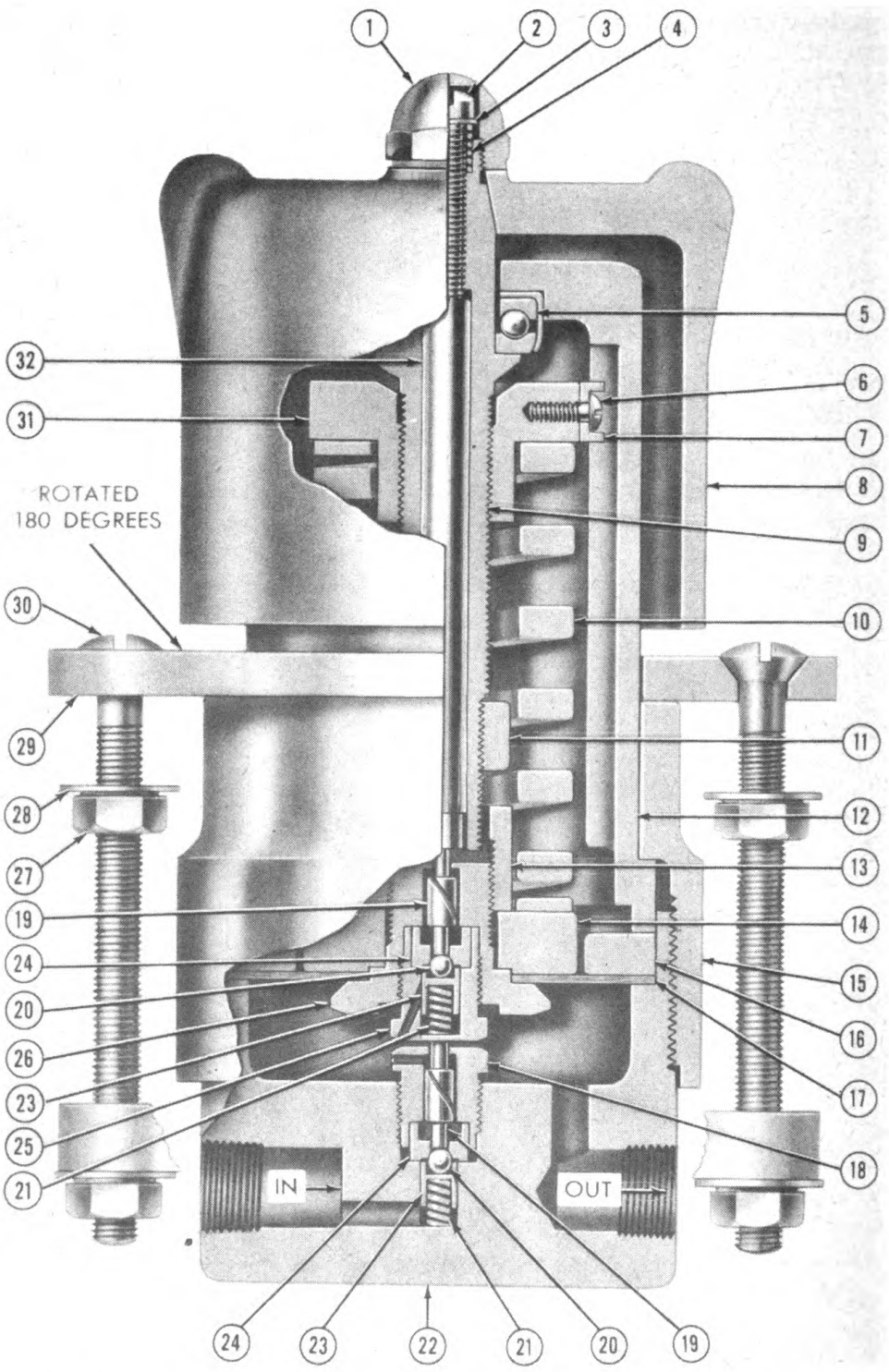


Figure 50—Atomizer air pressure regulator (sectional view). (Atomizer fuel pressure regulator is similar.)

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controlled, fast-acting internal main gun valve. This valve releases the main fuel from the gun and it is opened by air pressure and closed by spring action. The gun includes the following (figs. 51 and 52):

(1) Long nozzle extensions (two interchangeable sizes: ½-inch and ¾-inch bore).

(2) Short nozzle extension (¾-inch bore).

(3) Tapered nozzle (2-inch inlet, ¾-inch bore outlet).

(4) Vertical trunnion (gun body).

(5) Trunnion elbows (right and left).

(6) Main piston chamber.

(7) Main spring housing.

b. Either of the two long nozzle extensions is bolted to the short nozzle extension and tapered nozzle by means of a flanged adaptor held by four hex socket cap screws. The tapered nozzle is similarly attached to the forward end of the vertical trunnion (gun body). The vertical trunnion (gun body), a bronze casting machined on the inside, houses the perforated brass secondary fuel cylinder through which secondary fuel passes to coat the main fuel rod. The trunnion elbows, which support the gun and permit its elevation and depression, are fastened to the gun body by means of split, trunnion elbow collars with "O" rubber sealing rings forming a pressure-tight seal.

c. The vertical trunnion or gun body contains the main valve seat (a beveled metal ring, press-fitted permanently in place). The main piston chamber, which houses the main piston, is bolted to the rear flange of the gun body. The main spring housing is of machined steel, cadmium plated for corrosion resistance, and is bolted to the rear of the main piston

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Legend for Figure 50

1. Cap Nut
2. Relief Adjusting Screw
3. Relief Screw Washer
4. Relief Locking Spring
5. Thrust Bearing
6. Guide Button Screw
7. Guide Button
8. Handwheel
9. Stem
10. Loader Spring
11. Stop Nut
12. Spring Barrel
13. Diaphragm Nut
14. Diaphragm Plate
15. Sleeve
16. Clamp Plate
17. Diaphragm
18. Inlet Seat Retainer
19. Valve Pin
20. Valve
21. Valve Spring
22. Body
23. Valve Follower
24. Valve Seat
25. Relief Seat Retainer
26. Diaphragm
27. Mounting Nut
28. Mounting Screw Washer
29. Mounting Plate
30. Mounting Screw
31. Nut
32. Relief Stem

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chamber. The main piston spring is held in position around a main spring guide within the housing by means of a main spring housing nut screwed onto the main spring housing.

d. The following assemblies are considered a part of the E7R1 mechanized flame thrower gun:

(1) Main control valve.

(2) Pilot valve.

(3) Atomizer valve.

(4) Main gun valve.

61. LONG NOZZLE EXTENSIONS.

Interchangeable long nozzle extensions are provided for the flame gun in two sizes: ½-inch and ¾-inch bore. These provide the weapon with different fuel discharge rates, total firing time, and effective firing ranges. The ¾-inch bore extension gives a higher firing rate (gallons per second), longer range, and shorter total firing time per fuel load.

a. Removal. To remove long nozzle extension for replacement or to change size, proceed as follows:

(1) Remove the eight screws holding special dummy 75-mm. rifle tube cover.

(2) Lift off tube cover.

(3) Remove four hex socket head cap screws from long nozzle extension flange.

(4) Slide long nozzle extension forward slightly until flange seat is cleared; then lift flange end and move nozzle rearward until forward end of long nozzle extension is clear of atomizer nozzle, at front end of dummy tube (fig. 53).

(5) On removal from the flame gun, clean the long nozzle extensions thoroughly, using a rifle cleaning rod and swabs soaked with motor fuel. All thickened fuel must be removed from the bore before it has dried, otherwise the nozzle may become clogged.

(6) Clips have been provided on the forward hull wall for storage of the long nozzle extension not in use. The location of the clip is behind the ammunition box above the transmission housing. This location is accessible to the assistant driver.

b. Installation

(1) Replace gasket on long nozzle extension flange.

(2) Reverse procedure in **a** above, making sure all bolts and set screws are made up tightly and lock washers are used with each bolt.

62. TAPERED NOZZLE AND SHORT NOZZLE EXTENSION.

The tapered nozzle with flange ends tapers from 2-inch bore at the inlet to ¾-inch bore at the outlet (forward end). To this is attached a short

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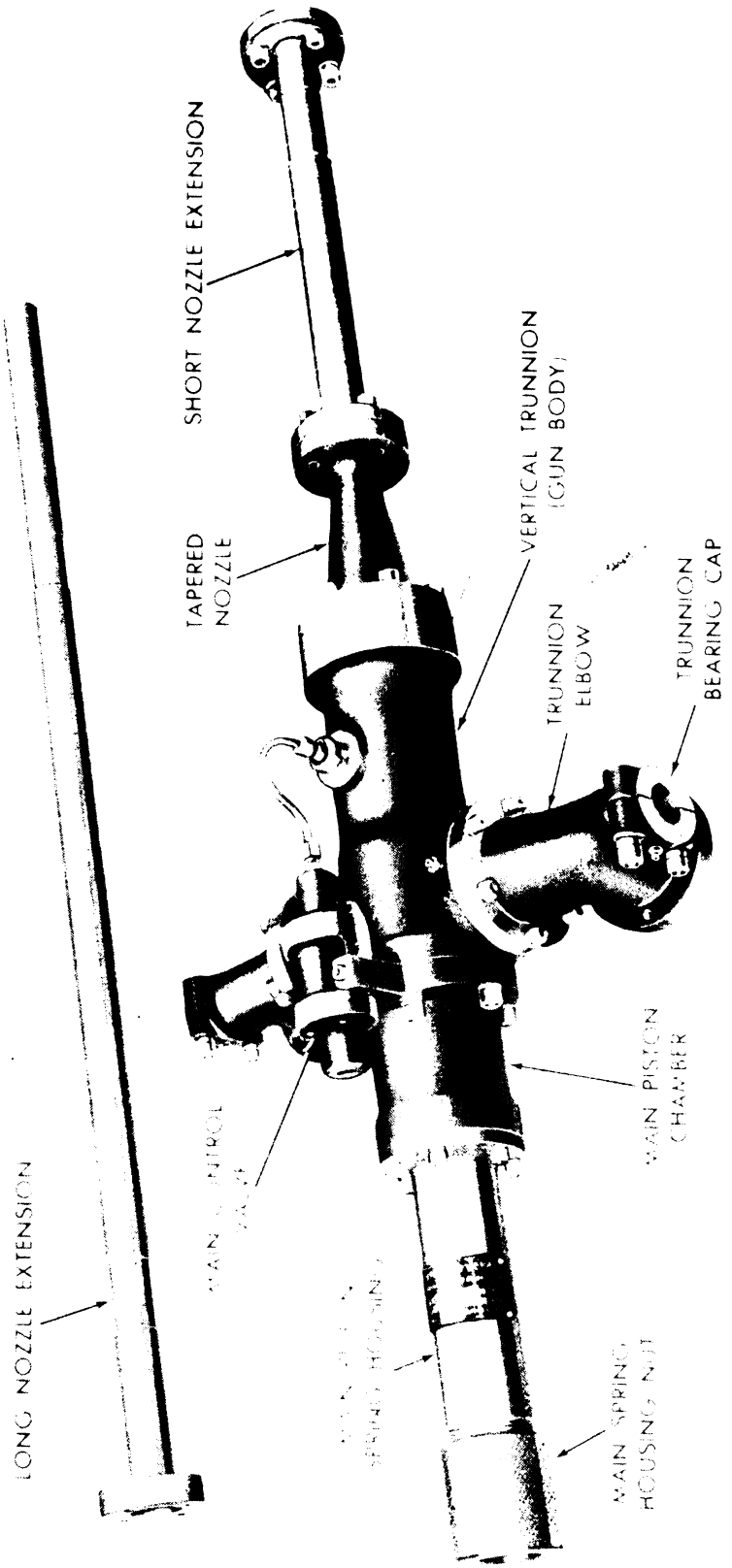


Figure 51—Flame gun, with long nozzle extension removed.

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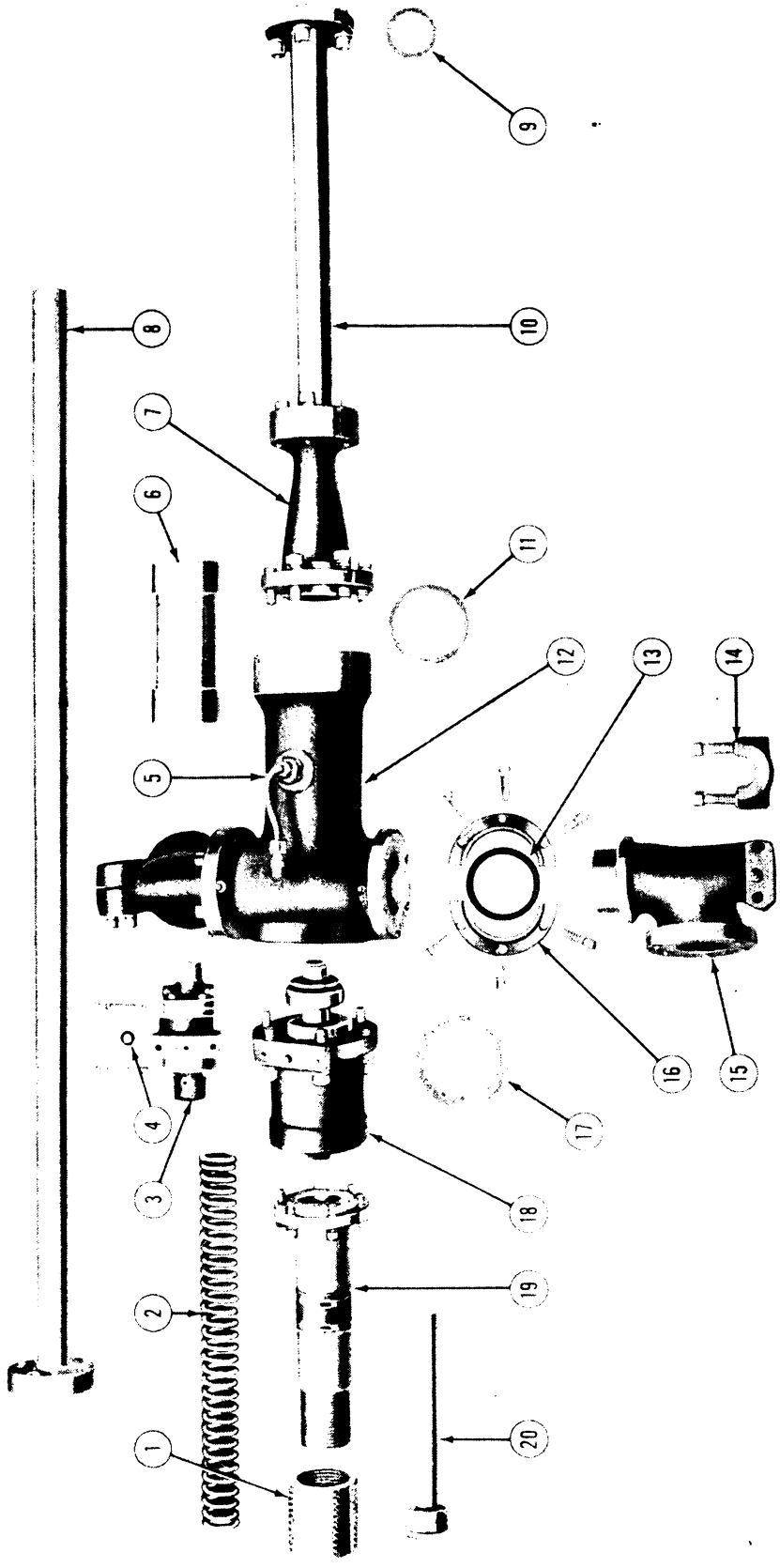


Figure 52—Flame gun (disassembled).

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nozzle extension of ¾-inch bore. It normally is not necessary to service these nozzles unless leakage around flanged joints is encountered, foreign matter becomes lodged in nozzle, or it becomes necessary to clean or replace perforated secondary fuel cylinders.

a. Removal. To remove tapered nozzle from gun body.

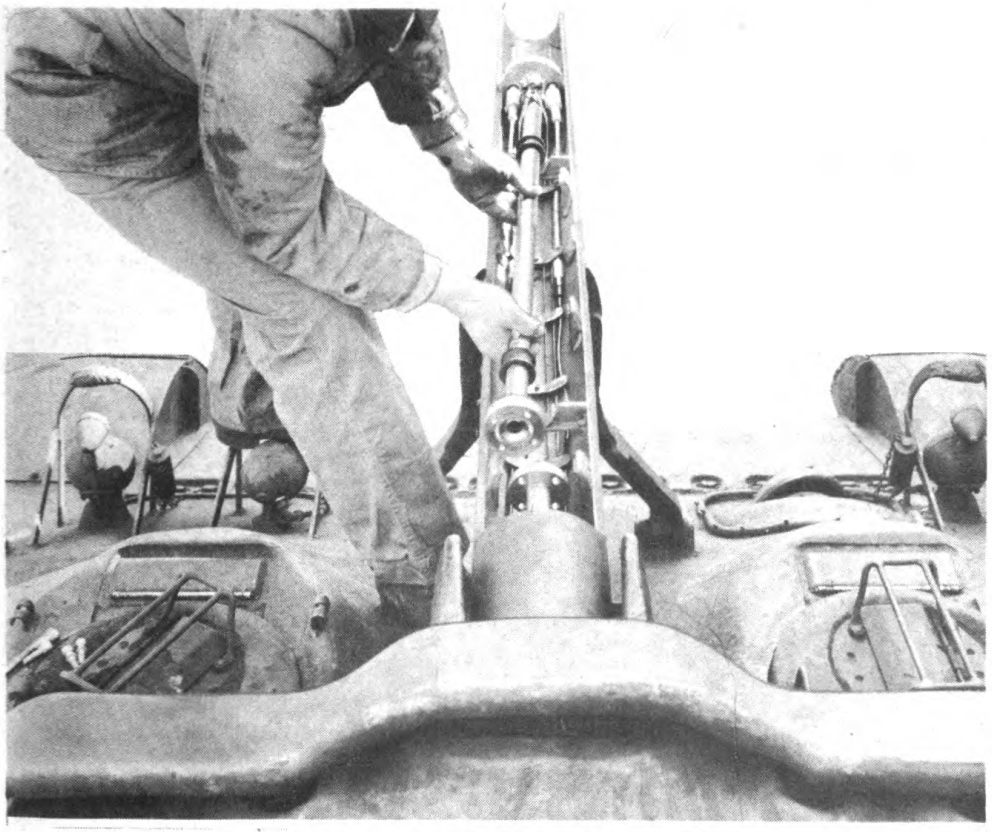


Figure 53—Removing long nozzle extension.

Legend for Figure 52

1. Spring Housing Nut
2. Main Spring
3. Main Control Valve
4. "O" Rubber Sealing Ring
5. Secondary Fuel Line
6. Perforated Secondary Fuel Cylinder
7. Tapered Nozzle
8. Long Nozzle Extension
9. Nozzle Extension Gasket
10. Short Nozzle Extension
11. Tapered Nozzle Gasket
12. Vertical Trunnion (Gun Body)
13. "O" Rubber Sealing Ring
14. Right Trunnion Bearing Cap
15. Right Trunnion Elbow
16. Trunnion Elbow Collar
17. Main Piston Gasket
18. Main Piston Chamber
19. Main Spring Housing
20. Valve Stop

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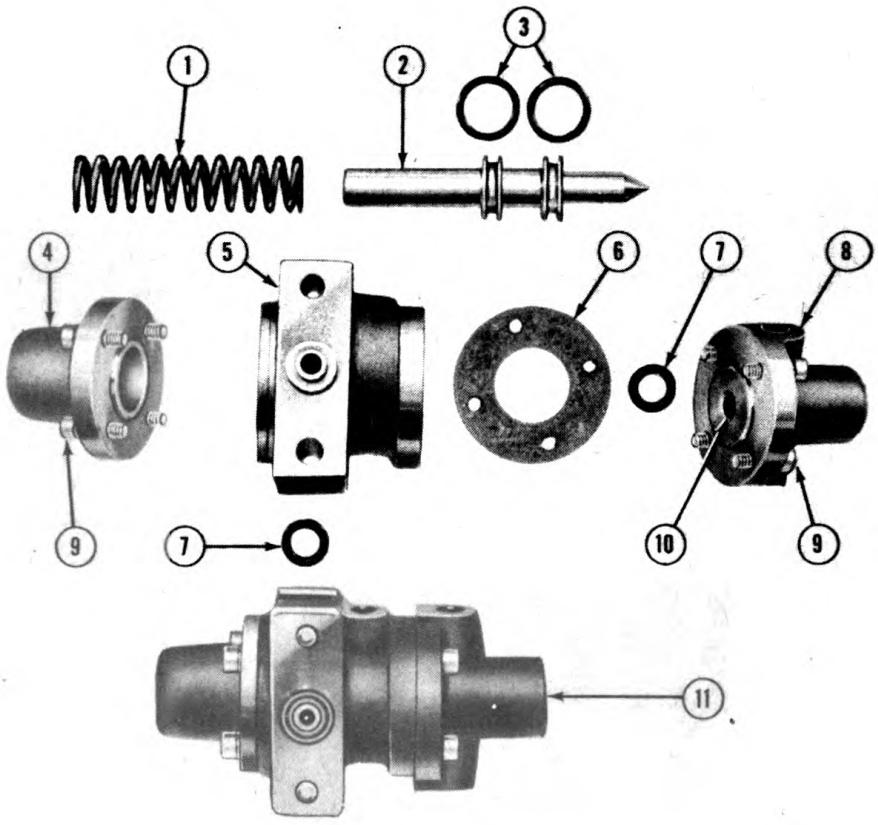


Figure 54—Main control valve (disassembled).

1. Spring
2. Piston
3. "O" Rubber Rings
4. Spring Housing
5. Valve Body
6. Gasket
7. "O" Rubber Rings
8. Bonnet
9. Cap Screws
10. Secondary Fuel Valve Seat
11. Main Control Valve Assembled

(1) Remove special dummy 75-mm. rifle tube as described in paragraph 73.

(2) Remove hex socket head cap screws holding tapered nozzle to vertical trunnion (gun body).

(3) Remove tapered nozzle and short nozzle extension. After this operation, the brass perforated secondary fuel cylinders may be removed for maintenance.

b. Installation. To install tapered nozzle, reverse above procedure,

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being sure that lock washers are used with all hex socket head cap screws and that latter are tightened.

63. MAIN CONTROL VALVE.

a. Description.

(1) The main control valve (figs. 52 and 54) has two functions:

(a) To control flow of pressured air into the main piston chamber, forcing the main piston backward and opening main gun valve so that fuel is expelled from the gun.

(b) To allow secondary fuel to flow into the forward gun body and thence through the perforated secondary fuel cylinder to coat the main fuel stream or "rod."

(2) In the main control valve, a control valve piston, normally held in a forward, closed position by a spring, acts as a combination air and fuel valve. Air for the operation of the main control valve itself is supplied from the pilot valve which in turn is actuated by the main fuel firing button or emergency fuel firing pedal. The main control valve comprises two sections, a forward bonnet (fuel body), and a rear air body, bolted together at a flanged joint. The air body contains two internal machined liners (not removable) cut so that annular spaces are formed between the cylindrical body and the liner. These annular spaces communicate with the interior of the valve by small holes drilled radially through the liners. Gun actuating air is constantly supplied to the forward annular space and is sealed off between the two piston flanges when the piston is in the closed position. The rear annular space delivers air through an air outlet leading into the main piston chamber when the piston is moved to the rear.

(3) When pressured air is delivered by the pilot valve, it enters the forward end of the air body in front of the forward piston flange, forcing the piston backward and compressing the spring. This movement connects the main air inlet with the air outlet leading to the main piston chamber. This opens the main gun valve. When the control valve actuating air is released by the pilot valve, the piston moves forward and permits air in the main piston chamber to vent back through a vent hole in the main control valve spring housing as the main gun valve closes. The forward end of the control valve piston passes through a hole in the rear of the bonnet, which contains an integral valve seat which is closed by the tapered end of the piston. Secondary fuel enters one side of the bonnet and flows out through the forward end when the piston is forced to the rear. The rear opening of the bonnet, through which the piston slides, is made air tight and fuel tight by a synthetic "O" rubber sealing ring (see Appendix, fig. 2).

b. Removal of main control valve from gun.

(1) The auxiliary air system in the turret basket should be vented by slowly opening the auxiliary air charging valve.

(2) Remove the gun-operating air hoses leading from the pilot valve and

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disconnect the secondary fuel inlet hose from the main control valve.

(3) Disconnect the secondary fuel line that leads from forward end of bonnet to the top of the gun body.

(4) Remove two hex socket head cap screws holding the control valve to the main piston chamber and lift valve off.

(5) Lift the main control valve discharge "O" rubber sealing ring out of its seat in the main piston chamber inlet port and examine for wear, cuts, or dirt. Clean and coat with light engine oil. Replace ring if necessary.

c. Disassembly of main control valve.

(1) After removing main control valve from flame gun (**b** above) remove the four hex socket head cap screws holding the main spring housing to the valve body.

> CAUTION: The spring contained in this housing is under considerable compression. Hold housing tightly to prevent it from flying off.

(2) Remove spring.

(3) Remove valve piston carefully so as not to damage "O" rubber sealing rings or forward tapered end of piston which serves as the secondary fuel valve stem.

(4) Remove four hex socket head cap screws holding forward bonnet onto the valve body, retaining gasket if undamaged. Replace gasket if damaged.

d. Maintenance of main control valve.

(1) Inspect all parts, clean thoroughly in motor fuel, and blow dry. Replace "O" rubber sealing rings if worn or cut, and coat rings thoroughly with light engine oil before putting piston back into valve body.

(2) Inspect the forward end of the piston for deep scratches. Smooth off lightly with crocus cloth to remove scratches. Do not polish piston out of round.

(3) If secondary fuel leaks through valve into gun body, regrind tapered end of piston in its seat using very fine valve grinding compound or suitable substitute.

e. Reassembly of main control valve and installation on gun.

(1) Reverse procedure in paragraph **c** above, tightening the screws that hold the bonnet first, to insure correct positioning of the tapered valve stem in the conical seat.

(2) Replace assembly on gun as in paragraph **b** above, and reconnect air and secondary fuel lines.

(3) Be sure to use lock washers with all cap screws.

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64. PILOT VALVE.

a. Description.

(1) The function of the pilot valve (figs. 55 and 56) is to supply air to operate the main control valve. The pilot valve is actuated by a special solenoid switch operated by the main fuel firing button (or mechanical emergency fuel firing pedal in case of solenoid failure). The pilot valve consists of a valve body, cylindrical perforated liners, and valve body covers, together with a pilot valve piston, sealing rings, and pilot valve spring. The whole unit, including solenoid, is bolted to a special bracket located forward in the turret to the left of the power traverse equipment.

(2) Into each end of the valve body is press-fitted a brass liner (not removable) which is machined to provide an annular space between liner and body. The two separate spaces so formed are each directly connected to a threaded opening in the valve body, one being the air inlet and the other the air outlet. A ring of holes drilled in each liner connects the annular spaces individually with the interior of the valve. Two piston flanges, which carry "O" rubber sealing rings, are spaced about ½-inch apart on the piston stem. The pilot valve spring is located between the forward piston flange and the valve body cover. A hole is drilled in the forward valve body cover to form an air vent. When the valve is closed, the spring holds the piston in the rearward position and the forward piston flange is located between the inlet and outlet ring of holes drilled in the liners. Thus, no air can flow between the two sets of holes. When the valve is forced open by the action of the solenoid or of the emergency fuel firing pedal, the piston moves forward and the piston flanges bracket the two sets of holes, allowing air to flow through the valve from the inlet to outlet ports. When the main fuel firing button is released, the piston is returned to the rear position by the pilot valve spring, while the air under pressure, on the outlet side of the valve to the main control valve actuating air chamber, vents through the hole in the valve body cover (fig. 55).

b. Removal and disassembly of pilot valve.

(1) Disconnect the air inlet and outlet hoses after making sure all pressure is released from the system.

(2) Remove the four hex socket head cap screws holding the valve to the valve bracket.

CAUTION: Hold on to valve as the compressed spring behind the piston will push it away from the bracket.

(3) Remove the piston, being careful not to damage sealing rings or score liner.

(4) Remove forward valve cover plate and pilot valve spring.

c. Reassembly and installation of pilot valve.

(1) Reverse procedure in paragraph **b** above. Be sure lock washers are used with all cap screws.

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(2) Connect hoses. Proper functioning of the valve can be checked by operating valve with discharge end of air outlet hose disconnected from main control valve.

d. Maintenance of pilot valve.

(1) Inspect "O" rubber sealing rings and replace them if they are cut or worn. Clean and coat new rings thoroughly with light engine oil prior to installation.

(2) Inspect liner for sign of scoring or rough spots and smooth off with

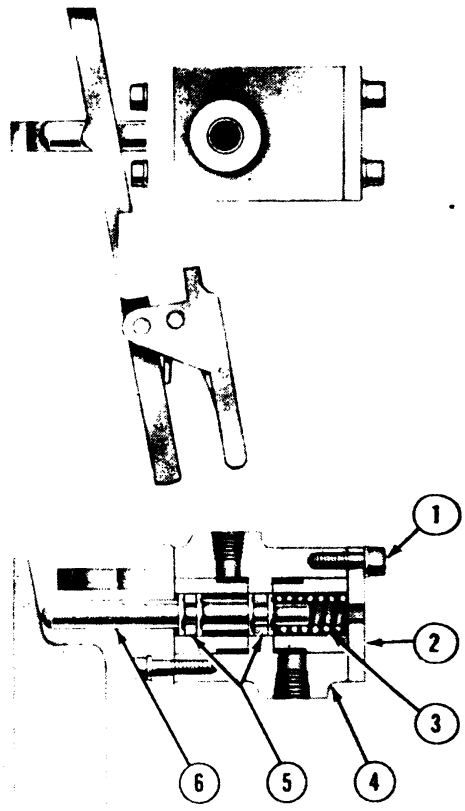


Figure 55—Pilot valve (sectional view).

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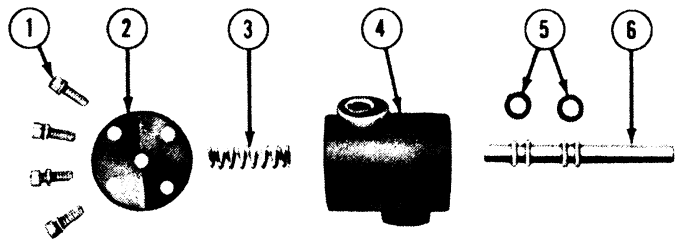


Figure 56—Pilot valve (disassembled).

Legend for Figures 55 and 56

1. Cap Screws and Lock Washers
2. Cover Plate
3. Valve Spring
4. Valve Body
5. "O" Rubber Rings
6. Piston

crocus cloth. If badly scored, replace with new part. Clean thoroughly in motor fuel and blow dry, making sure air holes in liner are clear by blowing through inlet and outlet ports.

(3) Smooth off lightly any rough scratches on piston flanges or stem with crocus cloth or very fine emery cloth and clean thoroughly. Place a few drops of engine oil on piston stem where it passes through the valve bracket cover plate.

65. ATOMIZER VALVE.

a. Description.

(1) The atomizer valve (figs. 57 and 58) supplies and controls flow of air and motor fuel to the atomizer nozzle. Adjacent parts are the atomizer air valve body (at rear) which is the same as the pilot valve body, and the atomizer fuel valve body (at front). The air valve body has an air inlet at the rear and an air outlet on the forward end. Construction is the same as for the pilot valve, with "O" rubber sealing rings on the air body piston. The piston has three "O" rubber sealing rings, the third being used to seal off the flow of atomizer fuel between the air and fuel bodies.

(2) The fuel valve body has inlet and outlet threaded openings. These ports are separated by a tapered valve machined as an integral part of the valve stem which seats in the body. The seat is integral with the valve body. The stem extends in both directions from the tapered valve. The forward end of the stem forms a guide for a piston spring. The rear extension of the stem passes through a central hole in the body casting, guiding the valve to its seat. The rear stem fits in a clearance hole drilled in the forward end of the air body piston. Forward movement of the piston

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hence moves the valve stem and valve forward, opening the atomizer valve. The atomizer valve spring is enclosed in a spring housing or bonnet.

(3) The action of the igniter pedal on this valve assembly pushes the air system and atomizer valve stem forward simultaneously and releases atomizer fuel and compressed air to the atomizer nozzle. Upon release of pedal, the atomizer valve spring returns the atomizer valve stem and air piston to its closed position, stopping flow of both atomizer fuel and air to the atomizer nozzle.

b. Removal and disassembly of atomizer valve.

(1) Make certain that all pressure is released from the basket atomizer fuel container and that the shut-off valve for the basket auxiliary air container is closed. Close the atomizer fuel outlet cock and turn the atomizer fuel pressure regulator handwheel counterclockwise to zero pressure. Because the fuel discharge lines from the valve contain some fuel, provision should be made to avoid spilling this inside the turret when the connections on the valves are opened.

(2) Disconnect the atomizer air hose, and the fuel inlet and outlet hoses.

(3) Remove the two hex socket head cap screws holding valve end plate to the igniter pedal bracket.

(4) Remove the four hex socket head set screws holding the valve body to end plate.

(5) Slide air piston assembly out, taking care not to damage rubber rings or score valve liner and piston shoulder.

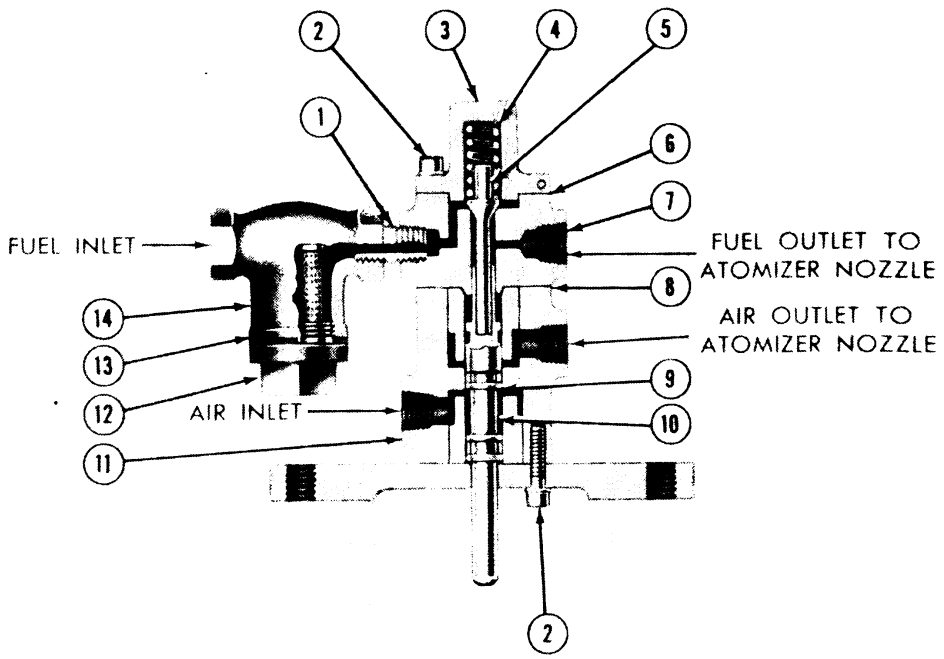


Figure 57—Atomizer valve (sectional view).

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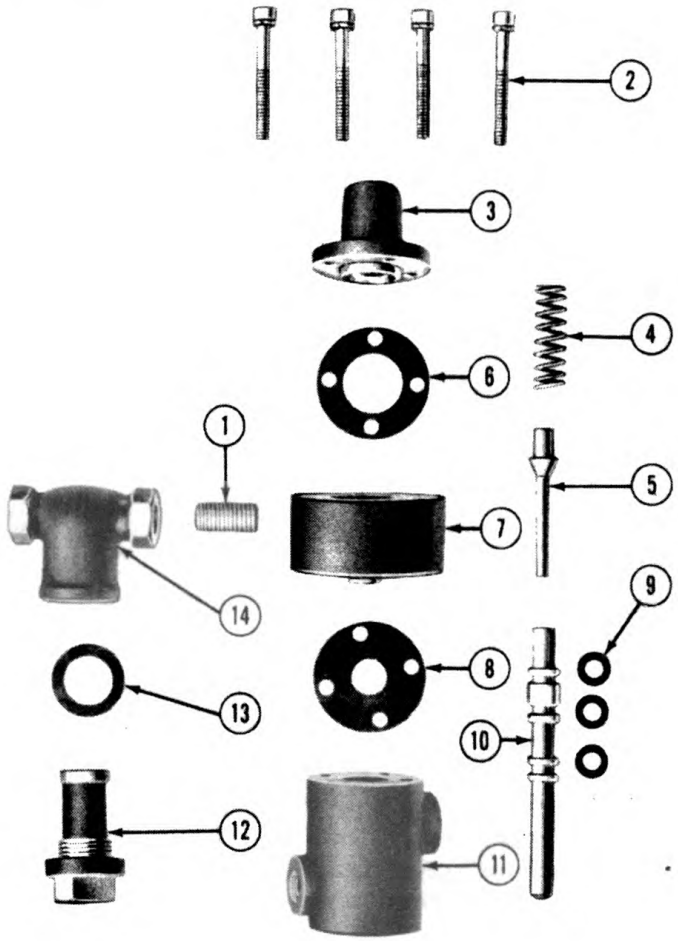


Figure 58—Atomizer valve (disassembled).

Legend for Figures 57 and 58

1. Nipple
2. Cap Screws and Lockwashers
3. Spring Housing
4. Spring
5. Fuel Valve Stem
6. Gasket
7. Fuel Valve Body
8. Gasket
9. "O" Rubber Rings
10. Air Piston
11. Air Valve Body
12. Strainer
13. Gasket
14. Strainer Body

(6) Remove the four cap screws holding the spring housing and remove carefully the atomizer valve stem and spring.

c. Reassembly and installation of atomizer valve.

(1) Reverse procedure in paragraph **b** above. All hex socket head cap screws must be assembled using lock washers. Tighten with wrench.

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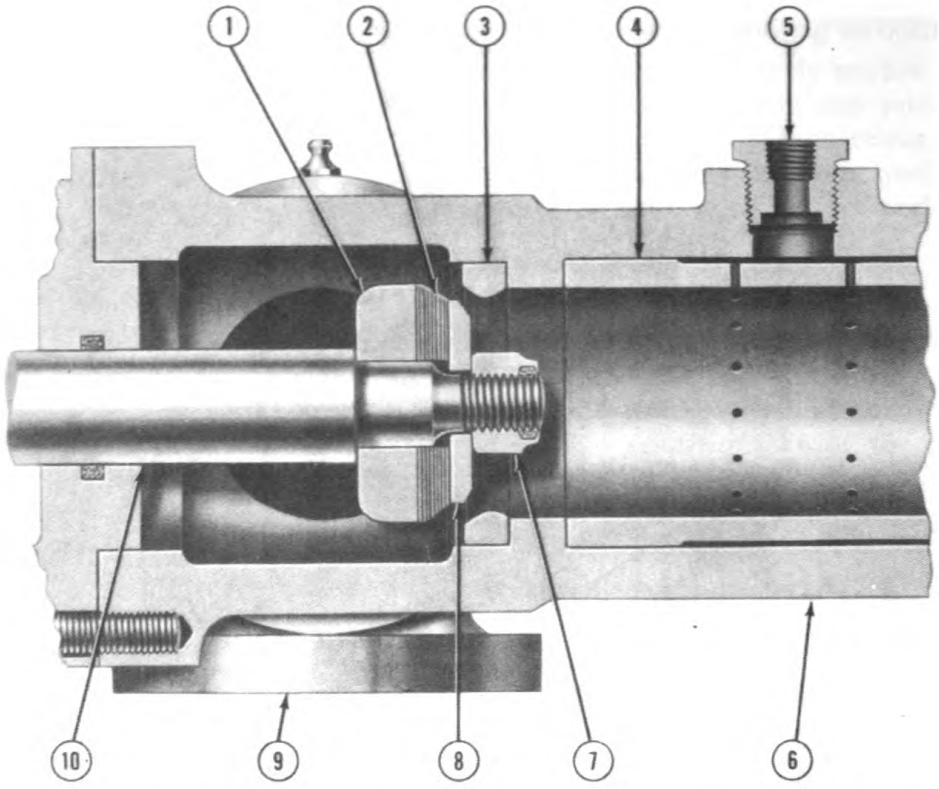


Figure 59—Main gun valve and vertical trunnion or gun body (sectional view).

1. Collar
2. Fiber Disk
3. Press Fitted Stainless Steel Main Valve Seat
4. Secondary Fuel Perforated Cylinder
5. Reducing Bushing
6. Vertical Trunnion (Gun Body)
7. Nut
8. Washer
9. Trunnion Elbow
10. Piston Rod

(2) After installation, check action of valve with air and atomizer fuel under operating conditions to assure proper functioning.

d. Maintenance of atomizer valve.

(1) Inspect all parts and clean thoroughly, making sure all passages are clean. Replace atomizer valve body gasket if necessary, using proper thickness ($\frac{1}{32}$ inch).

(2) If fuel leaks, look for grooving or scoring of valve stem or seat. It this is present, regrind with very fine abrasive (rouge or fine valve compound) to reseat valve properly. If atomizer valve stem is badly grooved or scored, replace, and grind in. If this does not remedy leak, replace atomizer valve.

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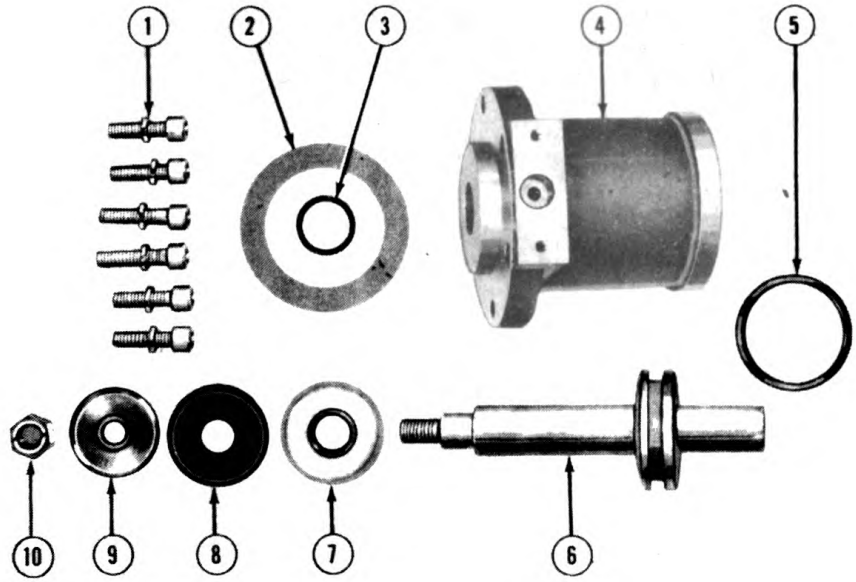


Figure 60—Main gun valve and main piston chamber (disassembled).

1. Cap Screws and Lock Washers
2. Gasket
3. "O" Rubber Ring
4. Main Piston Chamber
5. "O" Rubber Ring
6. Valve Stem and Piston Rod
7. Collar
8. Fiber Disk
9. Washer
10. Nut

(3) If air piston flange grooves or air body cylinder wall show scratches from action of dirt in valve, replace, or rub lightly with crocus cloth to remove scratches.

(4) Replace worn or cut "O" rubber rings and coat with light engine oil before replacing piston in valve body.

(5) Clean strainer in strainer body located ahead of atomizer valve.

66. MAIN GUN VALVE, MAIN PISTON CHAMBER, AND MAIN SPRING HOUSING.

a. Description.

(1) The main gun valve (figs. 59 and 60) and the main piston chamber are located together. On the forward end of the main valve stem is a specially formed fiber disk which seats against the metal ring seat in the gun body. This disk rests against the main piston collar and is held in place by means of a metal washer and an elastic stop nut. The fiber disk is replaceable. The valve stem passes through a central hole in the forward wall of the main piston chamber. Attached to the stem and riding

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in the cylindrical portion of the chamber is a piston. The hole through which the valve stem passes and the periphery of the piston are sealed by synthetic "O" rubber rings.

(2) Air admitted by the main control valve between the piston and the main piston chamber forward wall forces the valve stem and disk to the rear away from the seat of main gun valve, compresses the main piston spring, and permits discharge of fuel through the nozzle of the gun. The rear end of the piston rod serves as a centering device and support for the forward end of the main piston spring. To limit the travel of the valve to the rear on opening, a main spring guide (valve stop) about 8 inches long extends from the rear end inside the main piston spring coils. Contact of the piston rod with the forward end of the spring guide prevents the main valve head from contacting the chamber partition and sealing to it (see Appendix, fig. 2).

b. Removal. To remove the main gun valve, main piston chamber, and main spring housing, proceed as follows:

(1) Release all pressure and air from the flame thrower.

(2) Remove back of turret shield counterweight, pull out lead blocks, and then unbolt counterweight housing.

(3) Disconnect hoses from main control valve and remove valve.

(4) Unscrew main spring housing nut, using a strap wrench.

CAUTION: Hold nut firmly, as the compressed main piston spring will tend to force it off with about 200 pounds of pressure.

(5) Remove main spring guide and main piston spring.

(6) Remove main spring housing by taking out the six hex socket head cap screws holding housing to main piston chamber.

(7) Remove the main piston chamber by unscrewing cap screws threaded into gun body. Preserve the main piston chamber gasket if in good condition or replace if damaged (figs. 59 and 60).

(8) Slide main piston to rear of main piston chamber. Hold piston rod by a wrench to prevent rotation and then remove elastic stop nut with another wrench.

(9) Remove valve washer, fiber disk and main valve piston collar successively. The piston rod may now be pulled rearward through the partition of the main piston chamber.

CAUTION: Be careful not to damage "O" rubber sealing rings or mar piston stem.

c. Installation. To reassemble, reverse procedure outlined above after cleaning all parts thoroughly. Replace worn gaskets and any "O" rubber rings showing nicks, score marks, or general wear. Oil rings thoroughly with clean light engine oil prior to installation. Apply film of this oil inside main piston chamber and on main valve piston rod. Be sure disk is installed *tightly* to avoid flame gun drooling or valve leakage during operation. Be

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sure that lock washers are installed with all cap screws and that screws are pulled up tight.

d. Maintenance.

(1) Examine "O" rubber sealing rings on the main piston and in partition between main piston chamber and main gun valve. If rings are cut, worn, or loose fitting, replace with clean new rings after lubricating with clean light engine oil.

(2) Clean interior of main piston chamber, making sure air port from main control valve is clear.

(3) Measure free length of main piston spring. If spring length is 13¼-inch or less, replace with new spring. Coat spring with lubricant before installing (par. 24).

(4) Inspect fiber disk for grooving, nicks, or cuts, and replace if *any* defects are found. Failure to do this may result in leakage of main gun valve and "drooling" at the nozzle. Be sure disk is *tightly* installed, using new stop nut.

67. VERTICAL TRUNNION (GUN BODY).

a. Description. The vertical trunnion houses the brass perforated secondary fuel cylinder and the main gun valve seat. Two trunnion (rotary) elbows are bolted by split trunnion elbow collars to the flanges (fig. 52), one on each side of the vertical trunnion. Main fuel enters the vertical trunnion through these elbows without leakage at any elevation angle of the gun.

(1) Perforated secondary fuel cylinder. Within the forward part of the vertical trunnion is a brass perforated secondary fuel cylinder held in place by the tapered nozzle bolted to the front flange of the gun body. The secondary fuel cylinder is removable. An annular space is machined around the outside of the cylinder and this space is connected to the secondary fuel inlet of the vertical trunnion so that secondary fuel (motor fuel) may enter, pass through the perforations, and coat the main fuel stream before it leaves the nozzle.

(2) *Seat.* This seat inside the rear portion of the gun body is a beveled metal ring insert which is press-fitted into place and is not removable (fig. 59).

(3) *Trunnion elbows (left and right).* The two trunnion elbows support the gun in the turret, carry main fuel into the gun, and permit rotation of the gun in elevation and depression. The elbows include external mounting brackets which bolt to the trunnion pins in the rotor housing which rides in the turret trunnion bearings. A "Y" shaped pipe manifold from the main fuel container in the turret is bolted to the inlet flange of each trunnion elbow. The vertical trunnion is free to rotate on a horizontal axis around the trunnion elbows. Elevation and depression of the gun is provided for by a special rotary joint where the elbows join the vertical trunnions. This rotating joint consists of a machined sleeve (part

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of the trunnion elbow) which slips inside a flange on the gun body. The inside of the flange is grooved to hold an "O" rubber sealing ring which prevents fuel from leaking out. The trunnion elbow is held in place by a split trunnion elbow collar bolted in two matched halves to the flange.

b. Removal.

(1) *Vertical trunnion (gun body).*

(a) Before starting disassembly, release all pressure from fuel and air systems. Disconnect air and fuel hoses to main control valve.

(b) Remove turret shield counterweight after special dummy rifle tube is resting in gun carrier on turret exterior.

(c) Remove long nozzle extension (par. 61) and rearmost nozzle supporting bracket bolted in special dummy rifle tube.

(d) Remove the hex socket head cap screws holding trunnion elbow flanges to fuel feed manifold.

(e) Remove cap screws and cover caps on both trunnion elbow mounting brackets, and pull gun off trunnion pins rearward, to disengage from dummy tube. Be careful to avoid damaging high tension ignition cables and auxiliary tubing running from turret into dummy tube.

(f) Unbolt tapered nozzle from forward flange of vertical trunnion.

(g) Remove brass perforated secondary fuel cylinder by sliding forward out of vertical trunnion. (An alternate method of removing brass perforated secondary fuel cylinder is given in paragraph 62 a.)

(h) Remove screws which connect vertical trunnion (gun body) and main piston chamber.

(2) *Main gun valve seat.* Because this seat is press-fitted permanently into the vertical trunnion (gun body), it is not removable. If seat is damaged so that main fuel valve cannot be seated tightly, replace the vertical trunnion.

(3) *Trunnion elbows.*

(a) Follow procedure as in paragraph 67 b (1) *(a)* to *(e)* directly above, for removal of vertical trunnion (gun body).

(b) Remove the hex socket head cap screws which hold the split trunnion elbow collars to the vertical trunnion flanges. Remove trunnion elbow collars.

CAUTION: These split trunnion elbow collars are machined as matched pairs. Keep pairs together as originally installed. If they must be replaced, use only matched pairs.

(c) Slide trunnion elbows carefully out of vertical trunnion.

c. Installation of vertical trunnion. Reverse procedure outlined in **b** above.

CAUTION: Be sure to install lock washer with each cap screw and renew flange gaskets if necessary. Keep matched split trunnion elbow collars together in pairs.

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d. Maintenance of vertical trunnion.

(1) The perforations of the brass secondary fuel cylinders (lube blocks) should be inspected to insure that holes are clean for free passage of thickened or unthickened fuel. Clean holes with fine stiff wire and wash cylinder thoroughly with motor fuel.

(2) The main gun valve seat should be inspected for nicks due to valve closing on foreign material in fuel (stones, chips, or pieces of metal). The nicks if small may be removed with grinding compound. If large it is generally necessary to replace the vertical trunnion, because the flame gun may "drool" when the main valve seat is damaged. The main valve disk should be replaced if seat is ground in or vertical trunnion is replaced.

(3) Trunnion elbow maintenance is limited to inspecting "O" rubber sealing ring and condition of trunnion elbow sleeve surface. If ring is cut or worn, replace and lubricate with light engine oil. If sleeve is scratched or scored, smooth carefully with fine emery or crocus cloth. Grease the trunnion elbows well at the lubrication fittings located at the top and bottom of the flange on the gun body, using grease specified in paragraph 23.

Section XXIII. FLAME THROWER IGNITION SYSTEM

68. GENERAL.

The ignition system for the flame thrower gun provides air-atomized motor fuel ignited in the forward section of the dummy 75-mm. gun tube by means of two high tension sparks (fig. 33).

69. ATOMIZER NOZZLE.

a. Description. The atomizer nozzle is located in the forward part of the special dummy 75-mm. rifle tube just behind the ballistic plate. It is connected by two tubes and flexible hoses to the outlet air and fuel ports of the atomizer valve. Air and fuel are mixed within the nozzle body, this mixture emerging in the form of a narrow conical spray. The ¼-inch tubing supplies the 75 to 80 pounds per square inch air for atomization and the ⅛-inch tubing supplies fuel (fig. 47).

b. Position. The atomizer nozzle is held by a special bracket in a position ¾-inch to the rear and directly in line with the hole in the top of the ballistic plate.

> Note: The position of the nozzle with respect to this hole is important.

In order to obtain the proper ignition and combustion of the atomized fuel, it is necessary to mix the fuel with sufficient air. By positioning the nozzle ¾-inch behind the hole in the ballistic plate through which the spray passes, air is sucked in by the jet action of the spray. This air comes

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through the vent holes behind the ballistic plate and through the lower section of the dummy rifle tube wall. This air becomes mixed with the atomized fuel, giving an instantaneously ignitable mixture. If the atomizer nozzle is too close (less than ½-inch) to the rear of the plate, an improper mixture is obtained, which may result in unreliable ignition. If the nozzle is too far to the rear of the plate, some of the atomized fuel will strike the plate and cause fires in this rear section of the rifle tube and also again an improper mixture is obtained. A small atomizer nozzle drain pan with connection leading into the ignition chamber (forward end of dummy rifle tube) is provided to carry away any fuel leakage from the atomizer nozzle in case the atomizer valve leaks or the fuel drains from the nozzle feed line.

c. Removal of atomizer nozzle.

(1) Release all pressure from atomizer fuel and air system.

(2) Remove special dummy 75-mm. rifle tube cover.

(3) Unscrew couplings on atomizer air and atomizer fuel lines.

(4) Unbolt clamp from nozzle bracket and lift out nozzle.

d. Installation of atomizer nozzle. Reverse above procedure making sure nozzle is centered with hole in, and ¾-inch behind, the ballistic plate. The nozzle should point at approximately the center of the dummy gun tube muzzle opening.

e. Maintenance of atomizer nozzle. If foreign matter enters atomizer nozzle and obstructs or distorts spray, remove nozzle as above and then unscrew nozzle cap. Remove obstruction by blowing air through small air and fuel holes in nozzle. When replacing cap, screw on all the way and then tighten lock nut to prevent loosening of cap.

Note: Do not tighten lock nut until cap is seated on internal shoulder.

70. ELECTRICAL SYSTEM FOR IGNITION.

a. Description. Electrical ignition system consists of:

(1) *Ignition safety switch.* A toggle switch (fig. 5) with a red signal light is located in a special toggle switch box in front of the gunner above the turret switch. When light is on, 12-volt DC power from the vehicle battery is supplied to the switch at the foot control igniter pedal which actuates the ignition system.

(2) *Foot control igniter pedal.* The foot control igniter pedal (fig. 61), located on the floor and operated by the gunner's left foot, closes a switch when depressed and simultaneously actuates the atomizer valve. Two adjusting screws are provided on the foot pedal arm, one for the button (under the igniter pedal) and the other for the atomizer valve piston (on the forward end of the pedal arm). These screws allow proper adjustment to be maintained so that when the pedal is fully depressed the switch is closed and the atomizer valve piston is moved at least 5/16-inch. The adjust-

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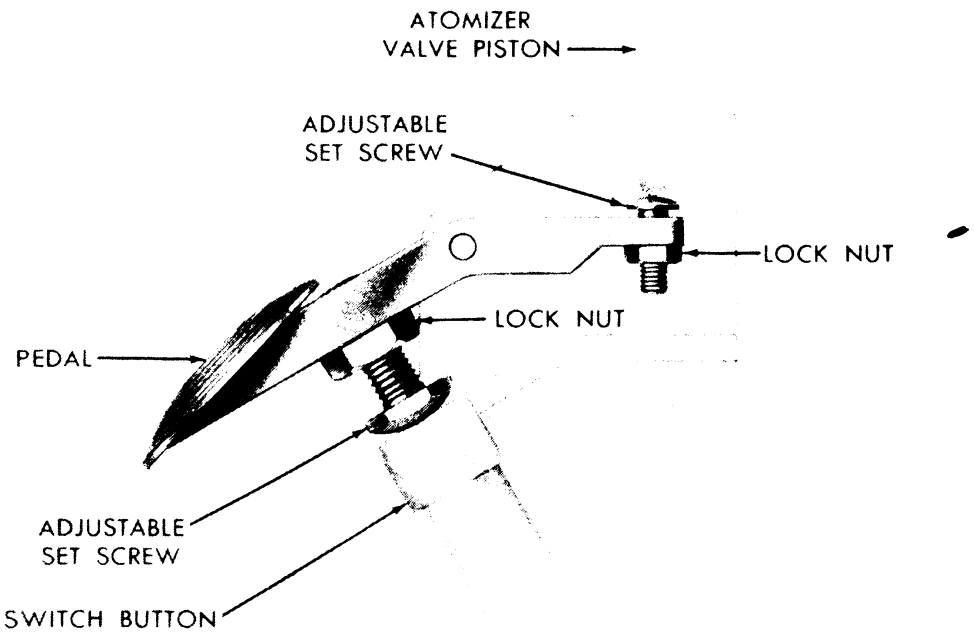


Figure 61—Adjustment of foot control igniter pedal.

ing screw under the atomizer valve piston should be set so that with the pedal in the off position, the screw head is at least $\frac{1}{16}$-inch below the end of the piston.

(3) *Coil boxes.* Dual ignition begins with two coil boxes, which are located on the roof of the turret over the flame gun. These coils provide high tension power individually to the two spark plugs. Each coil box is dust proof and splash proof, and contains an induction coil together with a resistor condenser and removable vibrator. These coil boxes are designed for 12-volt DC input and 12,000-volt AC output.

(4) *High tension ignition cables.* Two insulated 7-mm. high tension ignition cables extend from the outlets of the coil boxes through cable clamps inside the special dummy 75-mm. rifle tube to the spark plug terminals. The cables, for a short length adjacent to the plugs, are protected from possible fires around the atomizer nozzle by use of a special fireproof connector, made of special insulating material instead of the normal rubber-covered automotive high tension wire.

(5) *Spark plugs.* Two special spark plugs are screwed into the ballistic plate from the front (muzzle end of the special dummy 75-mm. rifle tube). The high tension plug terminals are to the rear of the plate and the

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insulated electrodes extend in front of the plate into the ignition chamber.

(6) *Ignition chamber ground electrodes.* A ground electrode is screwed into the side wall of the dummy rifle tube at right angles and slightly above the end of each of the two spark plug electrodes. The igniter sparks jump across the 1/16-inch gap between the spark plug and grounding electrodes.

b. Maintenance of electrical ignition system.

(1) *Foot control igniter pedal adjustment* (fig. 61). The foot control igniter pedal lever contains two adjustable set screws with lock nuts. Upon depression of the foot control igniter pedal, one set screw pushes down against the electrical ignition floor switch and the other set screw moves upward against the atomizer valve piston, actuating the atomizer valve. The two set screws should be adjusted, relative to each other, so that when the foot control igniter pedal has reached the bottom limit of travel, the floor switch button is fully depressed and the atomizer valve piston has been moved upward at least 5/16-inch from its "off" position. In the off position of the foot control igniter pedal, the set screw under the atomizer piston should be separated from the lower end of the piston by at least 1/16-inch. When the two pedal lever set screws are adjusted as above, lock each screw in this position by means of the lock nuts provided.

(2) *Coil boxes.* If sparks are not obtained at ignition chamber and if coil box fails to hum when igniter pedal is fully depressed and correctly adjusted (assuming the ignition safety toggle switch is on), open coil box by removing screws and replace vibrator (fig. 62). This is done by pulling vibrator out of socket connection (similar to a radio tube) and replacing with new vibrator. If coil box then fails to function, remove box and replace with complete coil box.

> Note: If a new coil box assembly is not available, it is permissible to substitute a standard Auto-Lite or Delco-Remy booster coil assembly (either 12-volt or 24-volt) until a replacement can be obtained.

(3) *High tension ignition cables.* Replace worn, burned, or cracked high tension ignition cables. Remove cover of special dummy 75-mm. rifle tube and remove screws from cable clamps holding cables in place.

(4) *Spark plugs.* Replace spark plugs having broken or cracked insulators. To remove, be sure turret ignition safety switch is in "off" position. Remove rifle tube cover. Disconnect special connectors from rear end of plugs. Then unscrew plugs from ballistic plate, using a 1/8-inch hex socket screw wrench or a steel rod inserted in the body holes provided. Reset spark gap for 1/16-inch by adjusting or bending slightly the ground electrode.

> CAUTION: Do not bend spark plug electrode as insulator will crack. Keep spark plugs, insulators, and electrodes clean of carbon and dried thickened fuel. Do not tighten spark plugs in place with any wrench except as indicated above.

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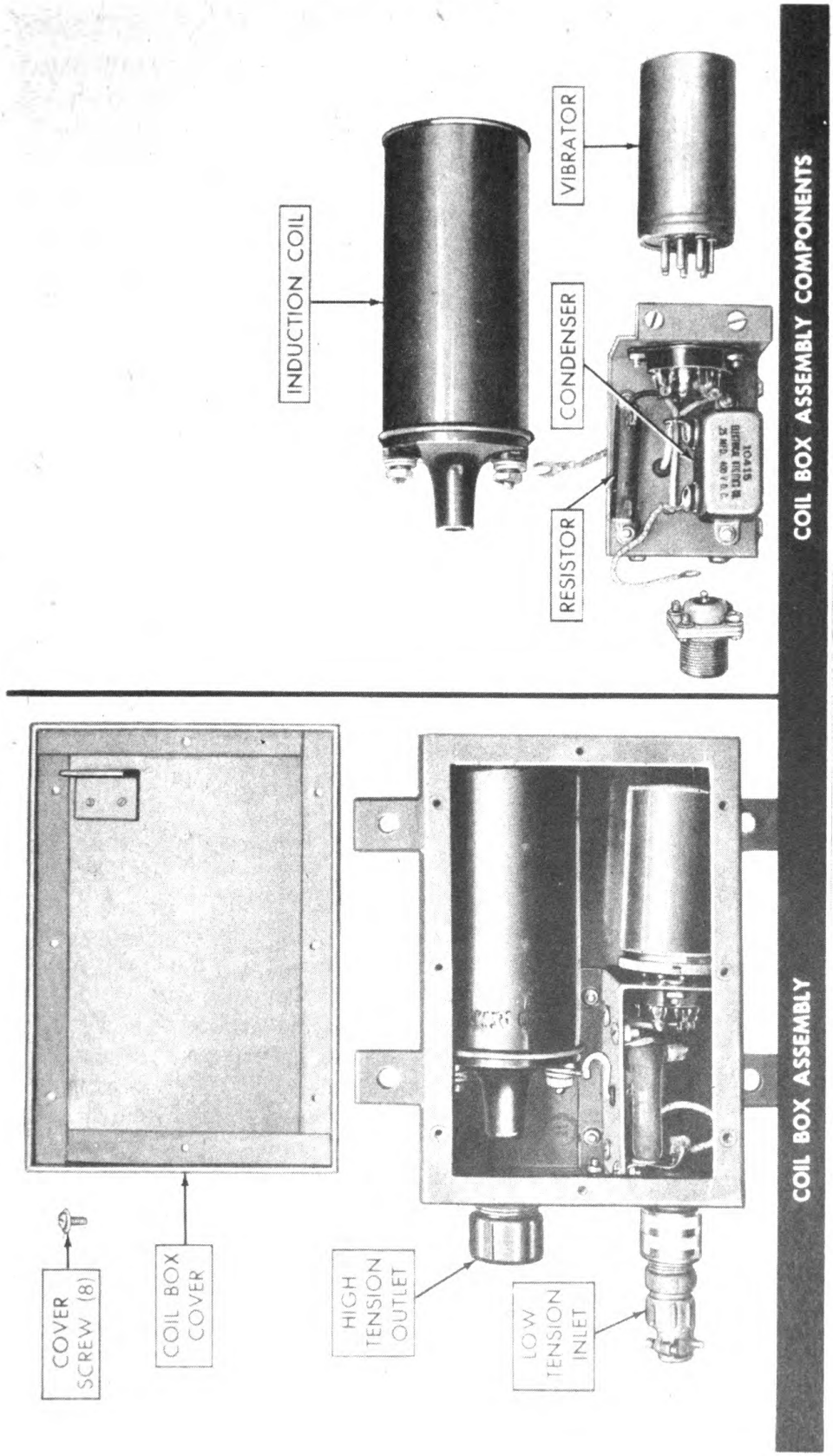


Figure 62—Coil box.

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71. CO_2 FIRE EXTINGUISHER FOR MUZZLE FIRES.

a. Description. So the gunner can put out immediately any residual fires in the ignition chamber due to burning fuel or leaks at the atomizer nozzle, a CO_2 "snuffer" system is provided (fig. 18 and Appendix, fig. 1). This comprises a 4-pound CO_2 cylinder bracketed to the turret wall near the roof and adjacent to the gunner. It is equipped with a trigger actuated valve, which is connected by ⅛-inch tubing to the ignition chamber and atomizer nozzle section of the rifle tube. This ⅛-inch tubing is held rigidly in the ballistic plate. A small (1/16-inch) hole drilled radially in the tubing projecting through the plate allows CO_2 to escape into the ignition chamber, effectively snuffing out residual flame in the muzzle. Similarly, another hole in the tubing behind the ballistic plate permits CO_2 to fill the gun tube directly behind the plate, thus extinguishing possible fires in this section and protecting the insulation on the high tension ignition cables. A flick of the trigger is normally sufficient to extinguish any burning material which may be deposited in the dummy rifle tube after flame gun firing.

b. Maintenance. Keep CO_2 cylinder fully charged by replacing bottle or having it refilled. Clean out small holes in front of and behind ballistic plate in ⅛-inch tubing CO_2 line with a fine wire, and frequently check clearance through CO_2 line by observing CO_2 ejection out dummy tube muzzle and through tube bottom air holes behind ballistic plate.

Section XXIV. SPECIAL DUMMY 75-MM. RIFLE TUBE

72. DESCRIPTION.

The special dummy 75-mm. rifle tube replaces the normal 75-mm. gun tube of medium tanks and duplicates its silhouette. This tube is fabricated from ½-inch face-hardened armor plate. The forward, tapered part is divided lengthwise into two halves which are held together by eight special stainless steel screws (fig. 63). By removing these screws, the cover (upper half) of the tube can be removed for servicing the flame thrower ignition system or for changing the flame gun long nozzle extensions (fig. 53).

a. Ignition chamber. The forward 11-inch space in the dummy rifle tube is the ignition chamber. It contains the spark plugs, ground electrodes, forward CO_2 extinguishing outlet, and outlet end of the flame gun nozzle.

b. Ballistic plate. This ¾-inch thick armor plate separates the ignition chamber from the remainder of the rifle tube (fig. 33). The long nozzle extension comes through a center hole in this plate. On each side of this muzzle in the 3- and 9-o'clock positions are the tapped holes into which the spark plugs are screwed. In the 12-o'clock position is another hole through which the air atomized spray of fuel and secondary air for combustion are ejected into the ignition chamber. The ballistic plate is welded only to the fixed bottom half of the dummy tube so that the dummy tube cover can be removed without disturbing the spark plugs or atomizer nozzle.

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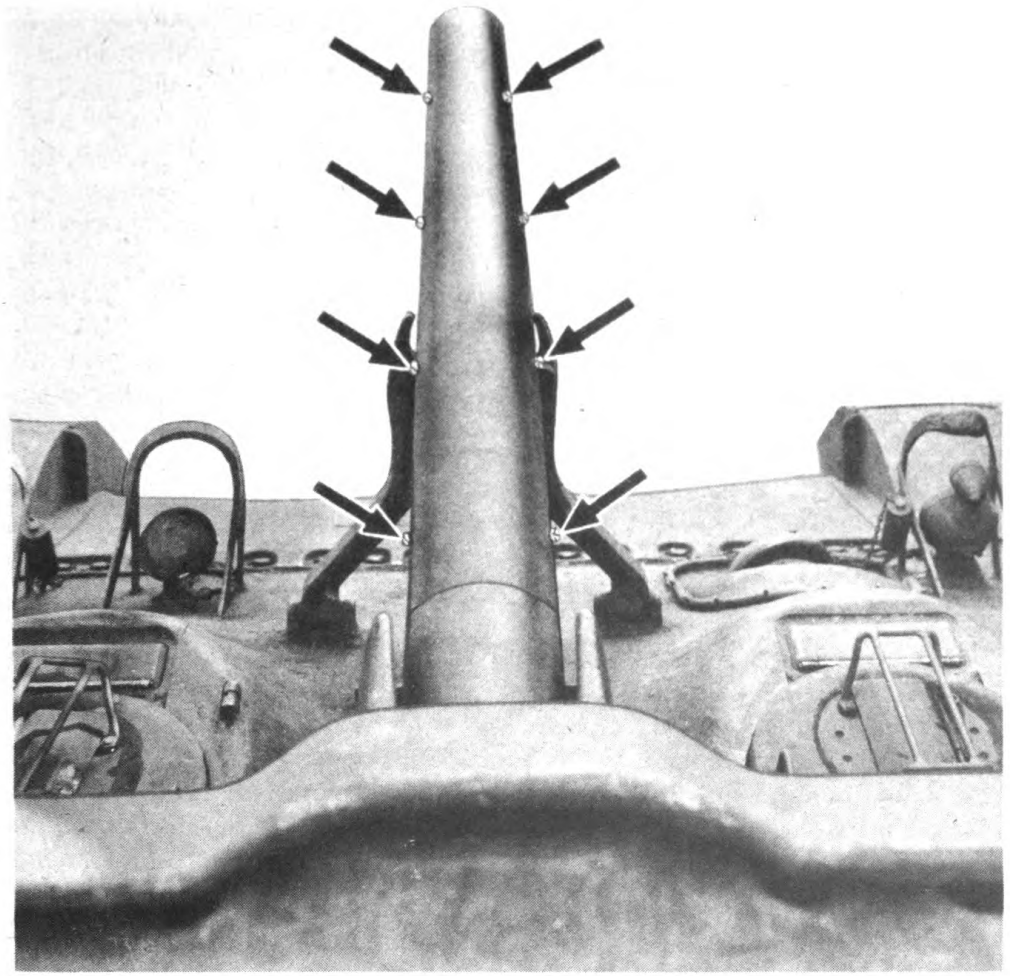


Figure 63—Special dummy 75-mm. rifle tube. (Arrows indicate screws for removal of tube cover.)

c. Nozzle supports and brackets. Behind the ballistic plate and welded to the lower half of the rifle tube is a support which holds the atomizer nozzle in position in the dummy rifle tube. Two additional supports are used to hold in position the long nozzle extension of the flame gun. Two nozzle gun sleeves, made of moulded rubber, are provided around the long nozzle extension to absorb ballistic or vibrational shocks. Five moulded synthetic rubber tube brackets are used to clamp the air and fuel lines leading to the atomizer nozzle, the high tension ignition cables, and the CO_2 "snuffer" tube, and to hold these lines slightly along the bottom of the rifle tube (fig. 33).

d. Method of anchoring rifle tube.

(1) The rear section of the rifle tube is cylindrical where it passes through the movable turret shield. A tapered collar is welded to the rifle tube so that it seats tightly in a tapered seat machined in the movable

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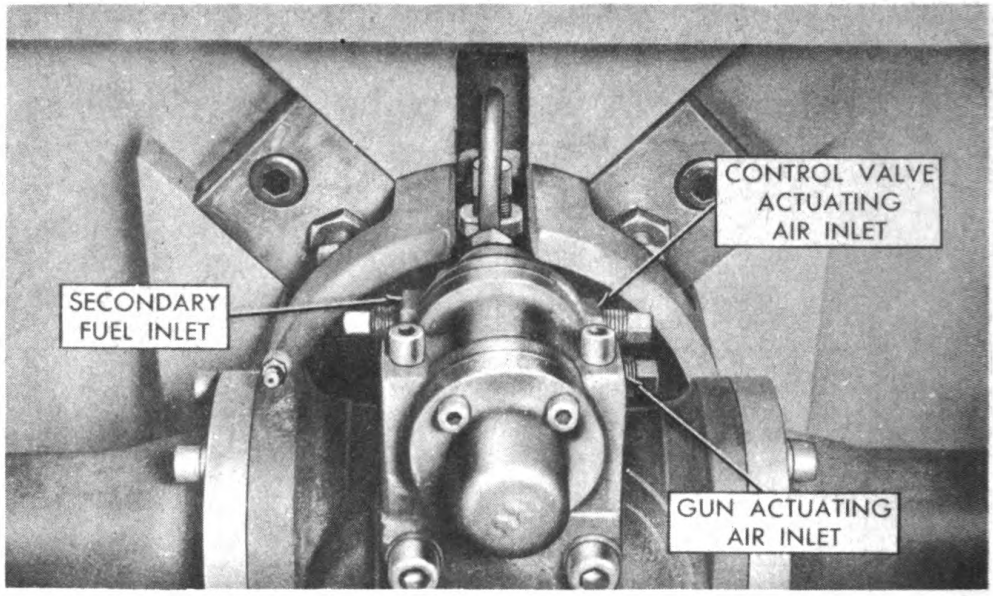


Figure 64—Breech end of dummy 75-mm. rifle tube.

shield, thus forming the forward support for the tube. At the breech end, in the cylindrical wall of the tube, are four rectangular holes 90 degrees apart to accommodate hold-down lugs and locking bolts (fig. 64). The hold-down lugs are bolted to the rotor mount or mounting yoke riding on the trunnion bearings. The locking bolts permit forcing the rifle tube to the rear into the tapered seat of the movable shield. Rear support for the tube is provided by a close fit in the rotor mount (mounting yoke).

(2) At the open breech end, a slot is provided at the top of the rifle tube to accommodate the goose-neck secondary fuel line leading from the main control valve on the flame gun body. A hole at the bottom of the rifle tube carries the atomizer nozzle air and fuel lines to the atomizer nozzle, the high tension ignition cables, and the CO2 "snuffer" line.

(3) The flame gun is mounted in the special dummy rifle tube on a gun flange pad ring. This ring is made of synthetic rubber which surrounds the forward gun body flange (fig. 33). This ring protects the flame gun by absorbing vibration and ballistic shock.

73. REMOVAL OF SPECIAL DUMMY 75-MM. RIFLE TUBE.

To remove the entire dummy rifle tube from its mount, proceed as follows:

a. Lift off tube cover after removing eight screws (fig. 63).

b. Remove flame gun long nozzle extension (par. 61).

c. Remove flame gun nozzle bracket located at rear of uncovered section of rifle tube.

d. Disconnect ignition cables, atomizer air and fuel connections, and CO_2 snuffer tube inside turret.

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Circuit Number	Wire Size	Circuit Name—Hull Electrical Circuits
1	18	Interphone—hull
2	18	Interphone—hull
3	18 Shielded	Interphone—hull
4	18 Shielded	Interphone—hull
5	12	12-v. interphone feed—hull
6	12	12-v. radio feed
7	2	24-v. slip ring feed
8	6	24-v. radio feed
9	0	Bus bar feed—24-v. sw.
10	0	Master switch feed
11	6	12-v. switch feed
12	0	Battery ground
13	0	Battery charging plug
14	0	Battery charging plug ground
15	0	Battery connector
16	2	Starter
17	2	Starter solenoid feed
18	14	Starter sol. operating
19	14	Starter switch feed
20	14	Fuel cut-off
21	14	Fuel cut-off switch feed
25	6	Eng. gen. reg. to bat. (M4A1 only)
25R	6	Rt. eng. gen. reg. to bat. (M4A3 only)
25L	6	Lt. eng. gen. reg. to bat. (M4A3 only)
26	12	Eng. gen. field (M4A1 only)
26R	12	Right eng. gen. field (M4A3 only)
26L	12	Left eng. gen. field (M4A3 only)
27	6	Eng. gen. arm. (M4A1 only)
27R	6	Right eng. gen. arm (M4A3 only)
27L	6	Left eng. gen. arm (M4A3 only)
28	6	Eng. gen. ground (M4A1 only)
29	6	Aux. gen. reg. to battery
30	12	Aux. gen. field
31	6	Aux. gen. arm.
32	6	Aux. gen. starter
38	14	Amm. to shunt—plus
39	14	Amm. to shunt—minus
40	3-12	Inst. box feed (M4A1 only)
40	8	Inst. box feed (M4A3 only)
41	14	Service head lamps
42	16	Service tail lamps
44	14	Blackout marker lights
45	16	Blackout tail lights
47	14	Blackout driv. lamp resister feed
48	14	Blackout driving lamp
49	12	Aux. switch to bus bar
50	12	Head lamps switch feed
51	14	Panel lamp switch feed
52	16	Panel lamps
54	18	Right dome lamp
55	18	Left dome lamp
56	18	Center dome lamp
58	14	Siren switch feed
59	14	Siren
60	12	Instruments feed
61	16	Oil pressure gage
62	16	Oil pressure pilot
64	16	Oil temp. ga.—eng. (M4A1 only)
65	16	Oil temp. ga.—trans. (M4A3 only)
66	16	Water temp. gage (M4A3 only)
67	16	Water temp. pilot (M4A3 only)
69	14	Accessory outlet socket
70	16	Fuel gage—right
71	16	Fuel gage—left
74	16	Fuel ga. to fuel ga. selector sw.
75	16	Mag. booster coil (M4A1 only)
76	14	Mag. cut-off—left
77	14	Mag. cut-off—right
83	12	Dome lamp cir. breaker feed

Circuit Number	Wire Size	Circuit Name—Turret Electrical Circuit
100	2	Turret switch box feed
101	18	Turret interphone
102	18	Turret interphone
103	18 Shielded	Turret interphone
104	18 Shielded	Turret interphone
105	12	Turret interphone feed
106	2	Turret motor cir. breaker feed
108	6	Turret 24-v. radio feed
109	14	Turret spotlight cir. br. feed
110	12	Turret gun & fuel fir. cir. br. feed
112	2	Turret motor feed
113	12	Turret gun firing switch feed
114	14	Turret gun firing foot sw. feed
115	14	Turret gun firing warning light
120	14	Turret .30 cal. firing sol. feed
121	16	Turret spotlight, reel feed, signal
122	14	Turret spotlight, socket feed
123	14	Turret blower feed
151	12	Turret gun & fuel firing sw. feed
152	12	Turret fuel firing foot sw. feed
153	12	Turret fuel firing solenoid feed
154	14	Turret fuel firing warning light
155	12	Turret ignition cir. breaker feed
156	12	Turret ignition switch feed
157	14	Turret ignition foot switch feed
158	14	Turret ign. feed to fuel sol. j.b.
159	14	Turret feed to left ignition coil
160	14	Turret feed to right ignition coil
161	14	Turret ignition warning light
162	12	Turret spotlight, dome lamp & blower cir. breaker feed

Table 2—Wire Schedule

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e. Raise dummy rifle tube to maximum elevation, using elevating gear in turret.

f. With a wrench, loosen lock-nuts on the four locking bolts at breech end of dummy rifle tube (fig. 64). Turn locking bolts *clockwise* until free.

g. Remove the four hex socket head bolts holding the four hold-down lugs to the rotor mount (mounting yoke) and remove lugs.

h. Have assistants hold dummy rifle barrel from outside vehicle.

i. Without rotating rifle tube use block of wood and hammer to drive rifle tube forward until the tapered collar is unseated.

j. Lift out barrel carefully so that fuel, air, and CO_2 tubing connections and the high tension cables do not become fouled.

74. INSTALLATION OF SPECIAL DUMMY 75-MM. RIFLE TUBE.

To install special dummy 75-mm. rifle tube, reverse procedure given in paragraph 73.

Section XXV. WIRING

75. DESCRIPTION.

a. Two 12-volt storage batteries in series furnish 24-volt current to the electrical system. A separate wiring system supplies 12-volts to the coil boxes in the turret, which in turn supply high tension current to the igniter spark plugs of the flame gun ignition system. The electrical apparatus is grounded to the hull to complete the circuit.

b. The major portion of the wiring in this vehicle has been relocated to accommodate the flame thrower system. The complete wiring diagrams for the hull and turret will be found in the Appendix. Table 2 shows the wiring schedule.

c. Circuits, including radio, interphone, and power for electric or hydraulic traverse, for the M4A1 and M4A3 medium tanks, are available in the turret. The special rotary joint described in paragraph 39 contains the electrical collector ring necessary to bring power into the turret. Relocation of the batteries is described in paragraph 86.

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Part Four

AUXILIARY EQUIPMENT

Section XXVI. GENERAL

76. SCOPE.

Part Four contains information for the guidance of the personnel responsible for the operation of this equipment. It contains only the information necessary to using personnel to properly identify, connect, and protect such auxiliary equipment while being used or transported with the main equipment. Detailed instructions pertaining to this auxiliary equipment are contained in separate technical manuals.

Section XXVII. FUELING AND PRESSURE CHARGING OF FLAME THROWER

77. GENERAL.

The fuel and compressed air or nitrogen may be considered as the ammunition for the flame thrower. The main and secondary fuels are the projectile; the main air or nitrogen pressure is the propelling charge; and the atomizer fuel and atomizer air, with the sparks, provide the igniter flame.

78. CHOICE OF FUEL.

a. The mechanized flame thrower is designed to fire thickened fuel (fig. 30) from the main fuel system, using from 4 to 10 percent U. S. Army fuel thickener in clean, dry motor fuel.

b. Providing there is satisfactory ignition of the fuel rod in the air, the following occurs when the percentage of thickener in the fuel is increased:

(1) Increase in effective firing range (center of deposit).

(2) Increase in the range of unbroken fuel stream or "rod" in the air.

(3) More effective penetration of fuel fired through small openings at a given range.

(4) Increase in the burning time of the fuel on the target.

Note: Thickened fuel containing 9 percent thickener has been reported to have sufficiently long burning time to explode ammunition within enemy fortifications.

(5) Decrease in obscuring effect from the burning fuel in the air by reducing the flame diameter of the fuel stream or "rod." (Variation in the secondary fuel rate, obtained by varying the secondary fuel pressure, also affects the flame "halo" around the fuel "rod.")

c. Specific tactical conditions should govern the desirable percentage of thickener to be used in the main fuel. If possible trial shots should be made to determine best fuel for the situation.

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d. Although not recommended for maximum effectiveness, unthickened or liquid flame thrower fuels can be fired. Liquid fuels are fuel oils or fuel oil blended with motor fuel, without thickening agents. If liquid fuels are employed, a maximum of approximately one quart (depending on diameter of nozzle employed) of liquid fuel remains in the nozzle chamber and extension after each shot except after blowing out remaining pressure at end of fuel load. This excess can be drained out of the gun muzzle if the gun is depressed.

79. FILLING MAIN FUEL CONTAINERS.

To add thickened or liquid fuel to the main fuel containers, proceed as follows:

a. Drive grounding stake attached to vehicle into the ground.

b. Connect hose to outlet hole in cover bolt of protected well in turret roof (fig. 24). Do not unbolt cover of protected well.

c. Open atomizer fuel filling cock, with atomizer fuel pressure regulator set at normal operating pressure (approximately 8 pounds per square inch). This blows any liquid trapped in well through hose over side of vehicle. Hold end of hose close to ground away from vehicle.

d. Open dummy periscope cover on left turret roof by removing bolt to expose filling connections in protected well (fig. 24).

e. Remove dust cap from main fuel quick-disconnect male hose coupling, and connect fuel servicing or filling hose. The fuel filling or servicing hose and overflow fuel hose herein mentioned are carried on the Service Units, Mechanized Flame Thrower E8 and E8R1 (fig. 23). Detailed use of the service units is stated in TM 3-361.

f. Connect overflow fuel hose (fig. 25) to the quick-connecting coupling on the main fuel vent line outlet, outside of the vehicle adjacent to the right rear hull air ventilator. Be sure this hose is not plugged.

g. Open main fuel vent cock (par. 10 c (4)) and vent all pressure from main fuel containers.

h. Be sure 1-inch main pressure regulator outlet cock is closed (par. 10 c (3)) and 2-inch emergency fuel shut-off cock (turret) is open (par. 10 d (7)).

i. Open main fuel filling cock in turret (par. 10 d (4)).

j. Fill main fuel containers from E8 or E8R1 service unit. As all main fuel containers are interconnected in series, it is not necessary to fill each container individually.

k. When fuel issues from overflow fuel hose, filling is complete.

l. Close main fuel filling cock in turret.

m. Close main fuel vent cock.

n. Disconnect fuel filling or servicing hose and overflow fuel hose, being

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careful to avoid spilling fuel on vehicle. If fuel is spilled, remove with a cloth or a wooden scraper.

o. Replace dust cap on main fuel quick disconnect male hose coupling. Be sure vent hole in cap is not plugged.

p. If E8 or E8R1 service unit is not available, an E6 (M10) flame thrower fuel filling kit may be used as described in TB CW 18. However, only liquid or comparatively thin thickened fuels may be filled by use of this kit.

80. FILLING SECONDARY FUEL CONTAINER.

Use clean motor fuel or aviation gasoline *free of water and without thickener,* as secondary fuel. Proceed as follows to fill container.

a. Close auxiliary air shut-off valve.

b. Remove filling-pipe cap on secondary fuel-filling line (½-inch pipe) in protected well in turret roof (fig. 24).

c. Open secondary fuel filling and vent cocks and vent all pressure from container.

d. Insert funnel with internal screen into filling pipe and pour fuel into container which holds approximately 12 gallons. The E8 or E8R1 mechanized flame thrower service unit carries a funnel of proper size designed for this filling operation. If this is not available, other funnel *with very fine strainer* such as chamois should be used.

e. When fuel overflows from vent line, close drain cock on funnel to prevent further overflow, and close filling and vent cocks inside turret. Wipe up excess fuel with cloth or blow out later as described in paragraph 79 b and c above.

f. Replace filling-pipe cap to keep dust and dirt out of line. Be sure vent hole in cap is not plugged.

81. FILLING ATOMIZER FUEL CONTAINER.

Clean motor fuel or aviation gasoline, *free of water and without thickener,* is used for this purpose. Proceed as follows:

a. Close auxiliary air shut-off valve.

b. Remove filling-pipe cap from basket atomizer fuel container filling pipe (fig. 24). This is located opposite the secondary fuel filling pipe (½-inch pipe).

c. Open atomizer fuel filling and vent cocks.

d. Proceed as for filling basket secondary fuel container. Basket atomizer fuel container holds about 2 gallons.

e. When full, close filling and vent cocks and replace filling pipe cap. Be sure vent hole in cap is not plugged.

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82. CHARGING PRESSURE CONTAINERS.

a. Sources of pressure.

(1) *E8 or E8R1 service unit.* Service unit, mechanized flame thrower, E8 or E8R1, is supplied with the flame throwers. They include an air compressor capable of delivering 26 cubic feet of air per hour at a pressure of 2,000 pounds per square inch. This compressor charges the main (hull) and auxiliary (turret) pressure systems of the flame thrower simultaneously within one-half hour. For information on operation of the service unit, see TM 3-361.

(2) *M1 compressors or commercial cylinders.* In an emergency, compressor, air, gasoline engine driven, 7CFM, M1 (3 cubic feet per hour at 2,200 pounds per square inch) may be used as described in TM 3-377. Another alternative is commercial cylinders of nitrogen or air equipped with a manifold which may be used as described in TM 3-376A, TB CW 17, or other publications on flame throwers. The latter two methods require considerably more time for charging. Suitable high pressure hoses and adapters must be provided.

b. Procedure.

(1) Make sure main pressure regulator inlet valve (fig. 11 and par. 10 c (2)) and auxiliary air shut-off valve are closed tightly.

(2) Connect one high pressure air hose through driver's hatch to pressure inlet connection for main pressure system in hull (fig. 10). This connection is located above and to rear of driver's seat.

(3) Blow out auxiliary air inlet connection in turret roof well (fig. 24) to clean it. To do so, open, then close quickly auxiliary air charging valve after roof well cover has been opened and connection tap removed.

(4) Connect the second high pressure air hose to the auxiliary air inlet connection in the protected well in the roof of the turret.

(5) Connect other end of both high pressure air hoses to dual connections on compressor discharge line of an E8 or E8R1 service unit (fig. 23), (or to manifold of an M1 compressor or commercial cylinders).

(6) Open main pressure charging valve (par. 10 c (1)) and auxiliary air charging valve (par. 10 d (1)).

(7) Charge both pressure systems simultaneously to the same pressure. One operator reads the pressure gages (0 to 3,000 pounds per square inch) in the right sponson or in the turret (par. 11 a) while another watches the gages on the compressor or commercial cylinders.

(8) When 2,000 to 2,200 pounds per square inch is indicated on the gages, close off the discharge from the compressor or commercial cylinders.

(9) Immediately after the above operation, close off the main pressure charging valve and auxiliary air charging valve.

(10) Before disconnecting high pressure air hoses, bleed the charging lines at compressor or cylinder manifold, to release pressure in the lines.

(11) Remove both high pressure air hoses.

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Note: If temperature drops appreciably after charging, a slight decrease in pressure may be noted in the main pressure and auxiliary air pressure gages. A drop of 200 pounds per square inch does not affect flame thrower operation. However, if the pressure drops below 1,800 pounds per square inch, then the system should be recharged to a minimum of 2,000 and a maximum of 2,200 pounds per square inch and the flame thrower should be checked for pressure leaks.

83. AFTER FUELING AND PRESSURE CHARGING.

After auxiliary air, main fuel, atomizer fuel, and secondary fuel filling and charging operations have been completed, bolt down dummy periscope cover on protected well and blow out any liquid therein (pars. 79 b and 79 c).

Section XXVIII. MODIFICATIONS OF MEDIUM TANK

84. GENERAL.

The medium tank in which the mechanized flame thrower is installed is a modified vehicle. As described in paragraph 3 b, modifications have been made in hull and turret stowage and it has been necessary to remove or relocate certain items.

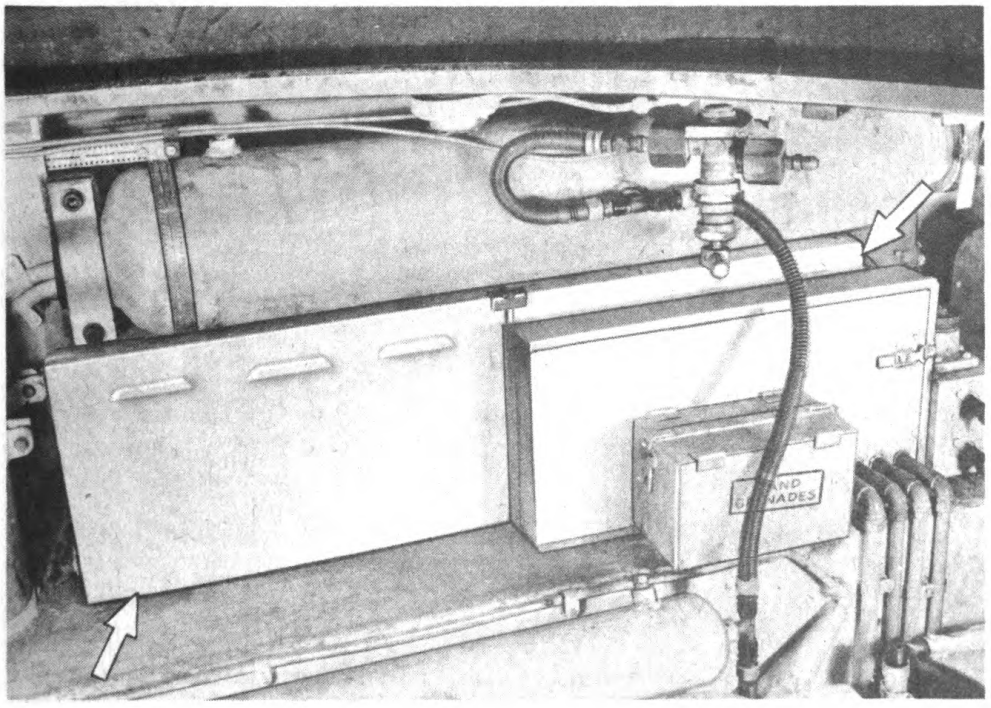


Figure 65—Battery box.

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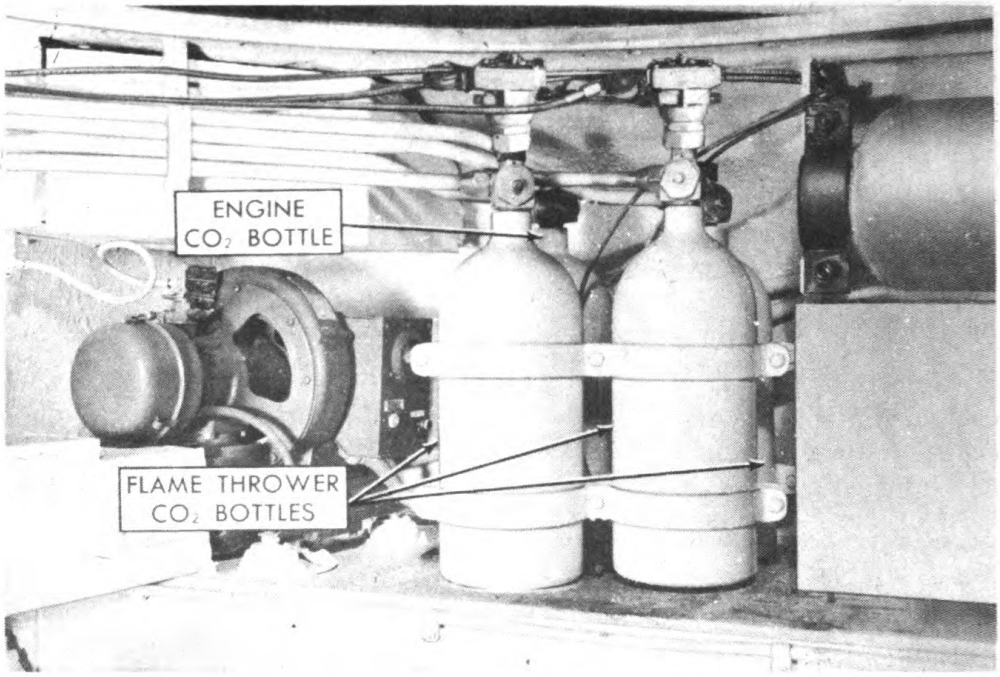


Figure 66—Auxiliary generator and CO_2 fire extinguisher cylinders on left sponson shelf.

85. SPECIAL SEAT.

The standard vehicle commander's seat in the turret has been replaced by a special seat which is adjustable vertically and may be folded down to avoid interference with the commander's standing room when the vision cupola is open. The adjustment range of the new seat permits use with the vision cupola either opened or closed.

86. VEHICLE BATTERIES.

The two 12-volt vehicle batteries have been moved to a special battery box located in the left sponson under the left sponson pressure container (fig. 65). To remove or service the batteries:

a. Rotate turret 180 degrees until the opening in the turret basket alongside the gunner is opposite the battery box (removal of gunner's seat will facilitate operation).

b. Lift up spring clamps holding battery box covers in place and loosen wing nut in front middle section.

c. Slide top covers out, thus exposing batteries for servicing.

d. If removing batteries, remove front panel of left box, disconnect left battery, and lift out through turret basket. Then pull other battery to the left until it can be lifted into turret basket.

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87. AUXILIARY GENERATOR.

The auxiliary generator has not been modified and its location is the same as in the normal medium tank (fig. 66). Access to the generator is possible from the basket by revolving the turret until the basket opening is opposite the generator.

88. CO_2 FIRE EXTINGUISHERS.

a. The normal automatic fire extinguisher system has been augmented and relocated in the left sponson forward of the auxiliary generator (fig. 66).

b. Remote control pulls for *both* the hull and engine compartment are provided. They are located behind and above the driver (top pull for hull system and bottom pull for engine compartment) and on the outside of the hull on the left side adjacent to the left fuel tank filling cap of the vehicle (left pull for engine compartment and right pull for hull system).

c. Four 10-pound CO_2 cylinders are provided; three discharge into the hull and one into the engine compartment.

d. Two portable CO_2 extinguishers are bracketed in the turret. One is a 2-pound extinguisher for general use. The other is a 4-pound extinguisher leading to the CO_2 "snuffer" for the flame gun (par. 71).

89. RADIOS AND INTERCOMMUNICATION.

a. The standard tank radio SCR-528 and interphone systems have been retained in the modified vehicle. Location is the same as in the normal medium tank.

b. One AN/VRC-3 radio for communication with supporting ground troops has been installed on the basket floor to the left rear of the commander's seat.

c. External interphone (interphone extension kit RC-298) is installed on the right rear of the vehicle for communication between personnel inside and outside the vehicle.

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Part Five

REPAIR INSTRUCTIONS

Section XXIX. GENERAL

90. SCOPE.

These instructions are published for the information and guidance of the maintenance personnel responsible for the third and higher echelon of maintenance of this equipment.

Section XXX. MAIN FUEL CONTAINERS

91. REMOVAL AND INSTALLATION.

a. General. In general, removal of main fuel containers from the vehicle is necessary only if replacement is required or if welding must be done on the containers.

> CAUTION: Vent all pressure from flame thrower before disassembling any pipe or flange connections. Before welding on any part of main fuel containers, the interiors of the containers must be steamed or thoroughly flushed with water to remove last traces of fuel vapors or thickened fuel. Before reinstalling, containers must be flushed with Diesel fuel oil and dried to remove residual water.

b. Basket main fuel container removal (fig. 35). To remove basket main fuel container (FB-1 in Appendix, fig. 1), proceed as follows:

(1) Remove any equipment which may interfere with access to parts.

(2) Unbolt flanged joints at inlet and outlet pipes from container.

(3) Unbolt brackets holding container to turret floor and mounting bracket.

(4) Remove vision cupola and turret hatch ring.

(5) Lift out container through turret hatch.

c. Basket main fuel container installation. To install basket main fuel container, reverse above procedure after inspecting container to insure freedom from dirt, scale, or liquids.

d. Hull main fuel containers removal. (Appendix, fig. 1). To remove the two hull main fuel containers (fig. 34) proceed as follows:

(1) Unbolt flanged joint under turret floor in fuel piping leading to the special rotary joint.

(2) Disconnect electrical cables leading to hull side of the special rotary joint.

(3) Lift off turret and basket, following standard practice for medium tank.

(4) Unbolt flanged joints in piping between hull main fuel containers.

(5) Disconnect piping leading from small pressure containers (AH-3,

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4, 5 and 6 in Appendix, fig. 1) bracketed to the hull main fuel containers.

(6) Unscrew union connecting pressure inlet line and fuel container.

(7) Disconnect at union in vent and safety head lines.

(8) Unscrew bolt holding fuel container brace to end supports.

(9) Lift out hull main fuel containers separately.

e. Hull main fuel container installation. To install hull main fuel containers, reverse removal precedure, after inspection has shown that containers are free of dirt, scale, or liquids.

Section XXXI. PRESSURE CONTAINERS

92. REMOVAL AND INSTALLATION.

Before proceeding with removal or installation of pressure containers, connecting lines, or any other parts of pressure systems, refer to detailed flow diagram given in Appendix, fig. 1.

a. All pressure must be released from fuel and pressure systems.

b. To remove pressure containers from hull or sponson it is necessary that turret and basket be disconnected and lifted out of vehicle.

c. Hull main fuel containers, FH-1 and FH-2, must be removed (sub-par. 91 d) to permit removal of small pressure containers, AH-4 and AH-5, located near the vehicle drive shaft.

Section XXXII. PRESSURE REGULATORS

93. MAIN PRESSURE REGULATOR.

a. General. The only parts of the main pressure regulator (RBX-306-04) (50 to 3,500 pounds per square inch inlet—5 to 1,000 pounds per square inch outlet) generally subject to wear or deterioration are valves, valve seats, and diaphragms. Damage of valve or valve seat always results in build-up of the reduced pressure (failure to hold regulated pressure). Deterioration of the diaphragm is indicated by a falling off of the reduced pressure. Failure of a diaphragm shuts off air flow completely. Before disassembling regulator, close main regulator inlet valve and main regulator outlet cock.

b. Valve, valve seat, and valve seat gasket removal (fig. 67).

(1) Using a wrench, unscrew body plug (9), which allows the valve spring (8) and valve (10) to be removed.

(2) Using the bushing wrench, unscrew seat bushing (7), which allows the strainer (11), valve seat (6) and valve seat gasket to be removed. Clean or replace strainer if necessary.

(3) Clean all seating surfaces well.

(4) Replace damaged parts, using new gaskets.

c. Valve, valve seat, and valve seat gasket reinstallation (fig. 67).

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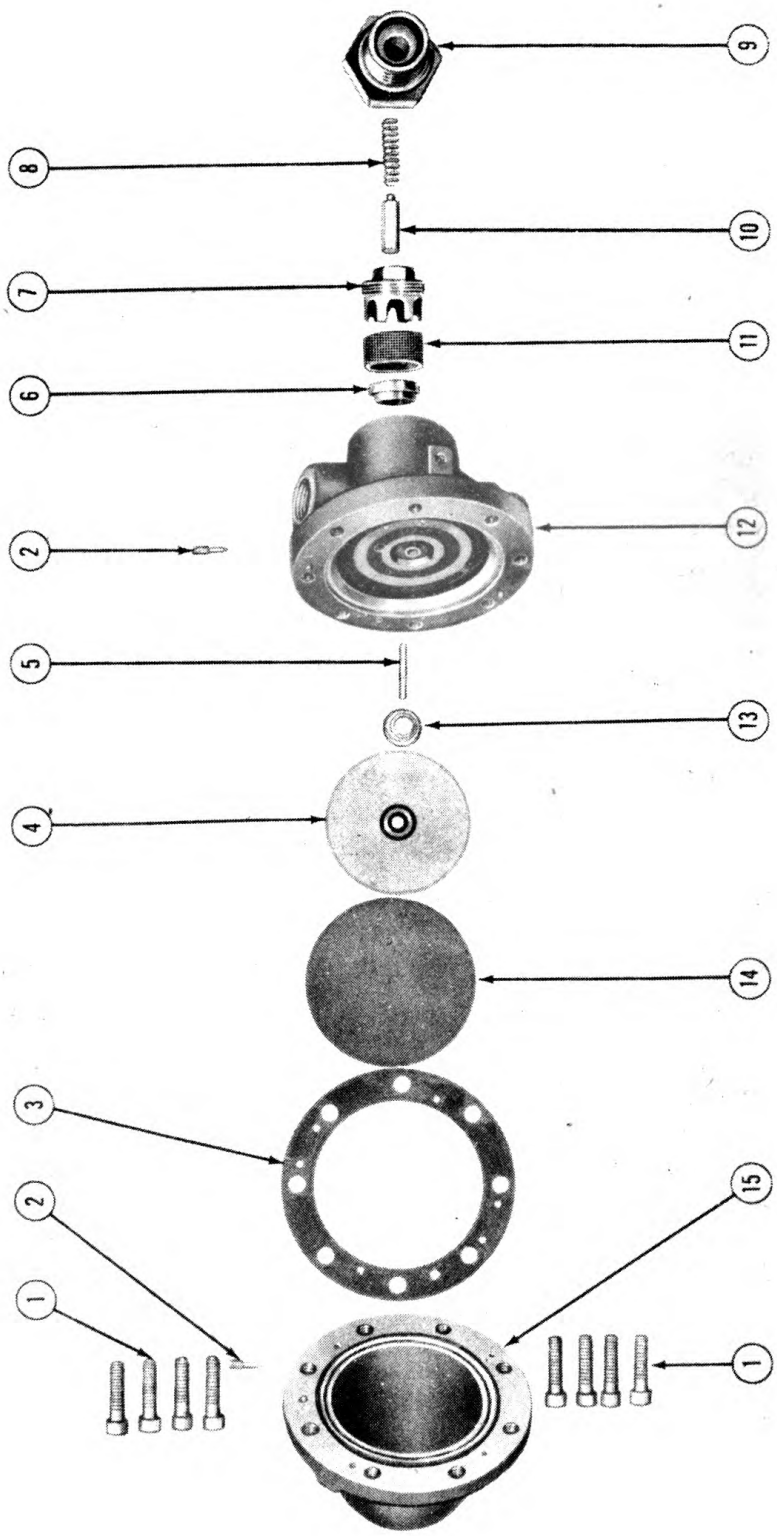


Figure 67—Main pressure regulator (disassembled).

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Reverse procedure in **b** above. If body plug (9) leaks after installation, remove and replace body plug gasket. The new body plug gasket should be softened first in boiling water (also heat body plug) until the gasket fits easily into the groove.

d. Diaphragm removal (fig. 67). Disconnect and remove regulator. Release all pressure from dome. Then proceed as follows:

(1) Unbolt and remove dome (15), after releasing all pressure from dome.

(2) Lift out diaphragm (14), plate (4), and spring (13).

(3) Replace diaphragm if necessary.

(4) Check hole in plate across bottom of dome to make sure it is clear.

e. Diaphragm installation.

(1) Install diaphragm spring and plate. Be sure plate is properly centered on the spring.

(2) Install diaphragm.

(3) Put back dome. Replace dome gasket (3) if necessary. The dome is so doweled as to fit only one way. Look for dowel pins before setting dome in place.

94. SECONDARY FUEL AND GUN ACTUATING AIR PRESSURE REGULATORS.

These regulators are of the Model 15-H spring loaded type (0 to 3,500 pounds per square inch inlet—200 to 1,000 pounds per square inch outlet).

a. Replacement of valve or valve seat of regulator requires disassembly of regulator (fig. 68). Before disassembling regulator be sure to discharge any pressure from the system. Proceed as follows:

(1) Disconnect inlet and outlet connections to pressure regulator.

(2) Remove pressure regulator from panel.

(3) Reduce loader spring (16) tension to minimum by turning handwheel (2) counterclockwise as far as it will go.

(4) Remove cap nut (1) and lift off handwheel.

(5) Unscrew sleeve (9) from body.

Legend for Figure 67

1. Capscrews
2. Needle Valve
3. Dome Gasket
4. Diaphragm Plate
5. Pushrod
6. Valve Seat
7. Seat Bushing
8. Valve Spring
9. Body Plug
10. Valve
11. Strainer
12. Body
13. Diaphragm Spring
14. Diaphragm
15. Dome

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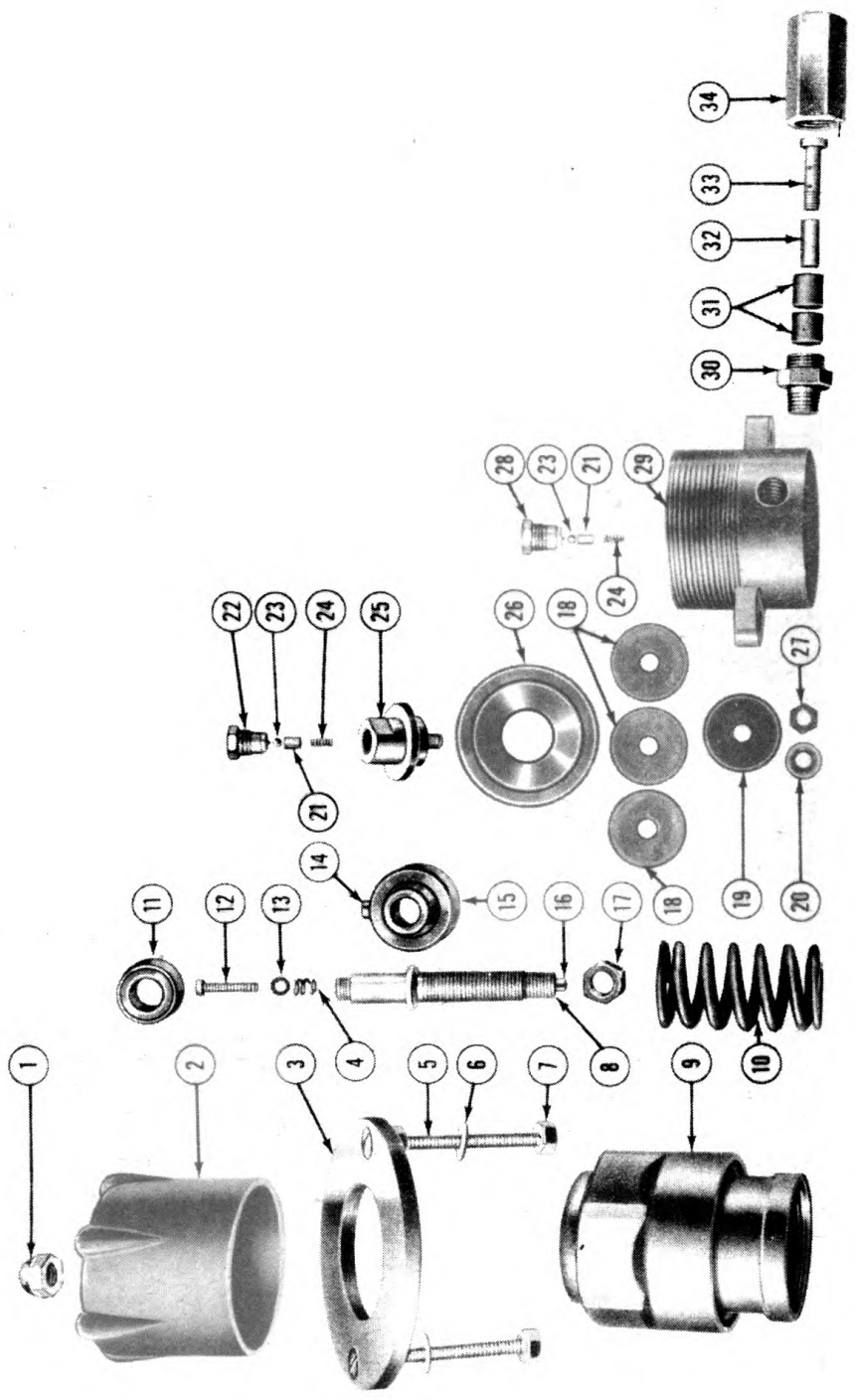


Figure 68—Secondary fuel pressure regulator (disassembled).
(Gun actuating air pressure regulator is similar.)

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(6) Lift off spring barrel, loader spring (16), and stem assembly (4).

(7) Tap body (24) with a piece of wood to loosen clamping ring (22). Remove diaphragm (19), relief assembly, and clamping ring.

(8) Unscrew inlet seat retainer (28).

(9) Lift out valve pin (21), valve seat (26), valve, and valve spring (27).

b. To replace diaphragm, or relief valve, and valve seat, proceed as follows:

(1) Carry out steps in paragraph **a** above.

(2) Hold diaphragm bolt (25) securely with a wrench and unscrew diaphragm nut (17). Lift off diaphragm plate (23) and remove diaphragm (19).

(3) Hold diaphragm bolt securely with a wrench and unscrew relief seat retainer (20). Lift out valve pin (21), valve seat (26), valve, and valve spring (27).

c. To reassemble regulator, reverse above procedures.

95. ATOMIZER AIR AND ATOMIZER FUEL PRESSURE REGULATORS.

These regulators are of the Model 15 spring loaded type (1,000 pounds per square inch maximum inlet pressure). Before removing or disassembling regulators make sure they are not under pressure.

> CAUTION: These regulators should not be used in the secondary fuel air or gun actuating air system as they are not built for the high pressure (2,000 pounds per square inch) existing at the inlet of these systems. The atomizer air pressure regulator has a loader spring with a range of 5 to 150 pounds per square inch

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Legend for Figure 68

1. Cap Nut
2. Handwheel
3. Mounting Plate
4. Relief Locking Spring
5. Mounting Screw
6. Mounting Screw Washer
7. Mounting Nut
8. Stem
9. Sleeve
10. Loader Spring
11. Thrust Bearing
12. Relief Adjusting Screw
13. Relief Screw Washer
14. Guide Button
15. Nut
16. Relief Stem
17. Stop Nut
18. Diaphragm Protector
19. Diaphragm
20. Diaphragm Plate
21. Valve Follower
22. Relief Seat Retainer
23. Valve
24. Valve Spring
25. Diaphragm Bolt
26. Clamping Ring
27. Diaphragm Nut
28. Inlet Seat Retainer
29. Body
30. Filter Cap
31. Felt Filter Elements
32. Filter Screen
33. Filter Core
34. Filter Body

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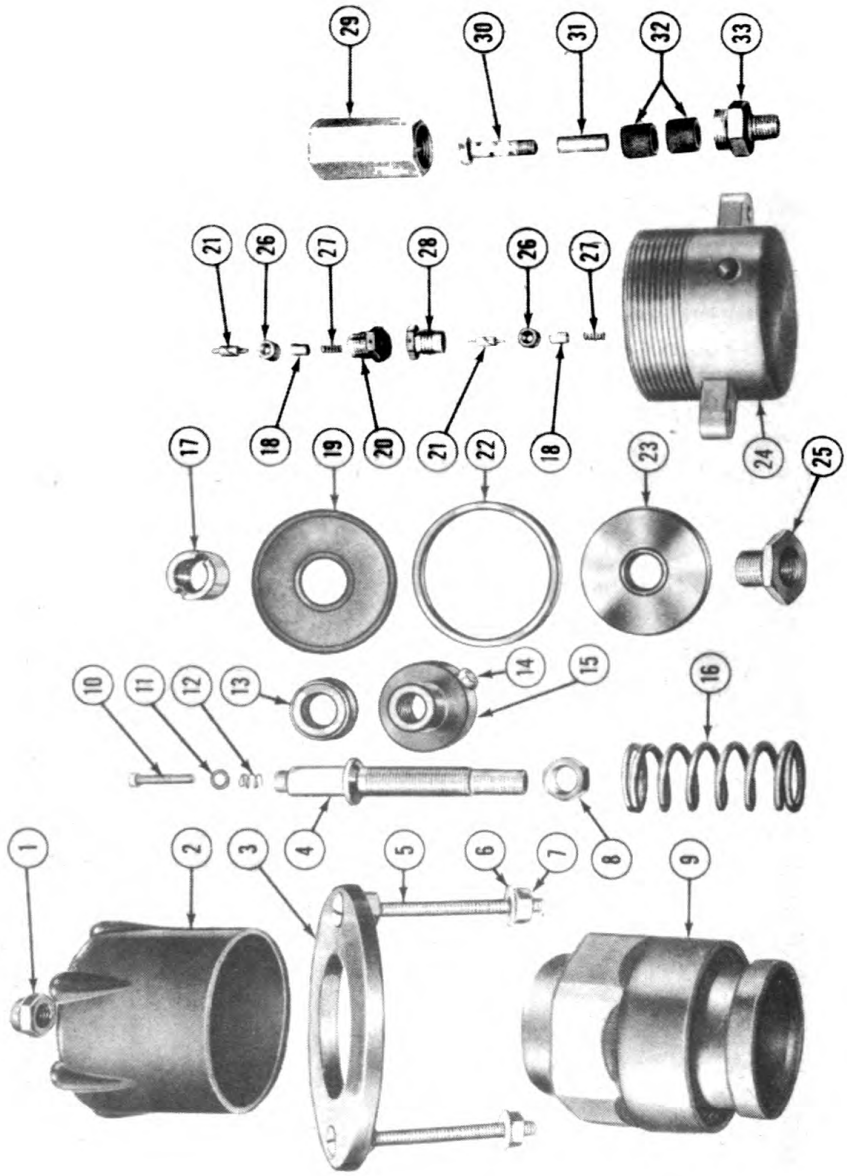


Figure 69—Atomizer air pressure regulator (disassembled). (Atomizer fuel pressure regulator is similar.)

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whereas the atomizer fuel pressure regulator has a loader spring with ½ to 25 pounds per square inch range.

a. Replacement of valve or valve seat requires disassembly of regulator (fig. 69). Before disassembling regulator be sure to discharge any pressure from the system. Proceed as follows:

(1) Disconnect inlet and outlet connections to pressure regulator.

(2) Dismount pressure regulator from panel.

(3) Reduce loader spring (10) tension to minimum by turning handwheel (2) counterclockwise as far as it will go.

(4) Remove cap nut (1) and lift off handwheel.

(5) Unscrew sleeve (9) from body (29).

(6) Lift off spring barrel, loader spring, and stem assembly (8).

(7) Tap body (29) with a piece of wood to loosen clamping ring (16). Remove diaphragm (19), relief assembly, and clamping ring.

(8) Unscrew inlet seat retainer (28).

(9) Lift out valve pin, valve seat, valve (23), and spring (24).

b. To replace diaphragm, or relief valve, and valve seat proceed as follows:

(1) Carry out steps in paragraph **a** above.

(2) Hold diaphragm bolt (25) with a wrench and unscrew relief seat retainer (22). Remove valve spring (24), valve (23), valve seat, and valve pin.

(3) Hold diaphragm bolt with wrench and unscrew diaphragm nut (27). Lift off diaphragm plate (20) and remove diaphragm (19).

c. To assemble regulator, reverse procedures in **b** and **a** above.

Legend for Figure 69

1. Cap Nut
2. Handwheel
3. Mounting Plate
4. Stem
5. Mounting Screw
6. Mounting Screw Washer
7. Mounting Nut
8. Stop Nut
9. Sleeve
10. Relief Adjusting Screw
11. Relief Screw Washer
12. Relief Locking Spring
13. Thrust Bearing
14. Guide Button
15. Nut
16. Loader Spring
17. Diaphragm Nut
18. Valve Follower
19. Diaphragm
20. Relief Seat Retainer
21. Valve Pin
22. Clamping Ring
23. Diaphragm Plate
24. Body
25. Diaphragm Bolt
26. Valve Seat
27. Valve Spring
28. Inlet Seat Retainer
29. Filter Body
30. Filter Core
31. Filter Screen
32. Felt Filter Elements
33. Filter Cap

Note: Loader Spring for Atomizer Air Regulator is set for 5 to 150 pounds per square inch; Loader Spring for Atomizer Fuel Regulator is set for ½ to 25 pounds per square inch.

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APPENDIX

Section I. SHIPMENT AND STORAGE

96. GENERAL.

The flame thrower is not removed from the vehicle except for repairs or maintenance. The medium tanks have been modified to accommodate the flame thrower and are thus special purpose vehicles. Necessary tools and accessories for the first echelon maintenance should be kept inside the vehicle.

Section II. REFERENCES

97. LIST OF REFERENCES.

Personnel responsible for operation and maintenance of the mechanized flame thrower should be familiar with the content of the following War Department publications:

98. ARMY REGULATIONS.

AR 850-20	Precautions in Handling Gasoline
AR 850-60	Compressed Gas Cylinders; Safe Handling, Storing, Shipping, Using

99. FIELD MANUAL.

FM 21-6	List of Publications for Training

100. TECHNICAL MANUALS.

TM 3-220	Decontamination
TM 3-361	Service Unit, Mechanized Flame Thrower, E8R1
TM 3-362	Flame Thrower, Mechanized, M3-4-3
TM 3-363	Flame Thrower, Mechanized, E5R2-M3
TM 3-364	Flame Thrower, Mechanized, M3-4-E6R3
TM 3-377	Compressor, Air, Gasoline Engine Driven, 7 CFM, M1 (for Charging Flame Throwers and Cylinders)
TM 9-731A	Medium Tank, M4 and M4A1
TM 9-759	Medium Tank, M4A3
TM 9-850	Cleaning, Preserving, Sealing, Lubricating, and Related Materials Issued for Ordnance Materiel
TM 37-250	Basic Maintenance Manual

101. TECHNICAL BULLETINS.

TB CW 17	Flame Throwers, Mechanized, E4R2-5R1 and E4R2-4R3-5R1
TB CW 18	Kit, Fuel Filling, Flame Thrower, E5

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TB CW 20 Cleaning Interiors of Compressed Gas Cylinders, Tanks and Accessories
TB ENG 39 Safe Handling of Compressed Gases

Section III. TENTATIVE RANGE DATA

102. GENERAL.

Effective flame thrower ranges depend on many factors. These include type of fuel (par. 103), nature of target, direction and velocity of wind (par. 104), presence or absence of dense underbrush, and model of the weapon used. Because of these variable factors, complete range data are not as yet available for mechanized flame thrower E12-7R1. Paragraphs 103 and 104 below present range data for some of the more usual conditions.

103. RANGES FOR CAVES, BUNKERS, AND ENCLOSED FORTIFICATIONS.

a. General. Embrasures, firing slits, ventilation openings, exits, and cave openings require close approach to the target so that the flaming fuel can be shot with maximum accuracy and velocity through openings into the fortification. Fuel burning on the outside of the target is generally wasted. The fuel should ricochet and billow inside the target, penetrating to the innermost areas of the fortification.

b. Test data. In a test, firing at openings in bunkers, fuel containing 6 to 6½ per cent of thickener was found to be most useful from the viewpoints of effectiveness, range, and ease of handling. Moreover, this fuel did not obscure target visibility. The ranges given in Table 3, below, may be reduced 10 to 20 yards by head winds or cross winds, depending on wind direction and velocity. Cross winds reduce range and accuracy more than head winds. Tail winds may increase the ranges by 5 yards or more.

Table 3
Range data for embrasures in fortifications, using ¾-inch nozzle.

Percentage of Thickener in Fuel	Farthest Range at Which Maximum Effects Are Achieved
4½	70
6	80
7½	80
9	80

104. RANGES FOR AREA TARGETS.

a. General. Area targets include enemy personnel and flammable materiel in the open terrain or in foxholes, trenches, and other uncovered fortifications. Longer ranges are possible for area targets than for embrasures, caves, and similar targets because requirements for accuracy and penetrating power are of less importance.

b. Test data. The ranges given in Table 4, below, may be reduced 20 to 50 per cent when firing cross wind, depending on wind velocity. Head winds have less effect on ranges that do cross winds.

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Table 4

Maximum range data for area targets (open terrain) using fuel containing 8 per cent thickener.

	Yards to Center of Ground Deposit	
	½-inch Long Nozzle Extension	¾-inch Long Nozzle Extension
10-degree Elevation		
No wind	95	113
5 mile-per-hour tail wind	103	125
10 mile-per-hour tail wind	108	138
20-degree Elevation		
No wind	105	140
5 mile-per-hour tail wind	121	154
10 mile-per-hour tail wind	133	167

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